EXHIBIT 1

IN THE UNITED STATES DISTRICT COURT
FOR THE DISTRICT OF NEW JERSEY

IN RE: JOHNSON & JOHNSON TALCUM POWDER PRODUCTS MARKETING, SALES PRACTICES AND PRODUCTS LIABILITY LITIGATION ***THIS DOCUMENT RELATES TO ALL CASES***	**MDL NO. 16-2738 (FLW) (LHG)**

EXPERT REPORT OF MARY POULTON, PHD
FOR GENERAL CAUSATION *DAUBERT* HEARING

Date: February 25, 2019

Mary Poulton, Ph.D.

The following report is provided pursuant to Rule 26 of the Federal Rules of Civil Procedure. My opinions are as follows:

I. SUMMARY OF OPINIONS

In their expert reports, Drs. Cook[1] and Krekeler use flawed methodologies, incomplete sampling results, and incorrect facts about ore body characterization and selective mining to reach their conclusions that the talc sourced for Johnson's Baby Powder and Shower to Shower was known to contain asbestos and heavy metals that exceeded product specifications. Based on analysis of the reports of Drs. Cook and Krekeler, examination of documents presented, use of reference literature, and my engineering experience, I conclude to a reasonable degree of scientific certainty the following:

A. Drs. Cook and Krekeler improperly conflate non-ore samples with ore samples.

B. Drs. Cook and Krekeler improperly conflate non-asbestiform minerals with asbestiform minerals.

C. Drs. Cook and Krekeler improperly extrapolate general mineralogy from different regions to the exact mineralogy of ore that went into Johnson's Baby Powder or Shower to Shower.

D. Dr. Cook improperly conflates the mineralogy of non-cosmetic grade talc mines with cosmetic grade ore that went into Johnson's Baby Powder or Shower to Shower.

E. Dr. Krekeler improperly cites data regarding regions in China where talc was never sourced for Johnson's Baby Powder or Shower to Shower to opine that the specific Chinese ore body sourced for Johnson's Baby Powder or Shower to Shower was contaminated with asbestos.

F. Drs. Cook and Krekeler rely on irrelevant test results for their opinions that Johnson's Baby Powder and Shower to Shower were contaminated with asbestos.

G. Dr. Cook relies on test results that postdate production for cosmetic talc at the Argonaut mine, which cannot be extrapolated to ore sourced from earlier sections of the mine as mines are continually in development.

H. Drs. Cook and Krekeler's opinions regarding inadequate sampling are premised on misrepresentations of documents and sampling theory and lack evidentiary support.

I. Drs. Cook and Krekeler incorrectly assert that selective mining was impossible, make improper assumptions about how drill campaigns must be conducted, misstate facts regarding mine planning and rely on incomplete data to opine that quality control was ineffective.

[1] Reference to January 22, 2019 amended report by Dr. Cook used throughout this report.

II. MY QUALIFICATIONS

I received a B.Sc. degree in Geological Engineering with Distinction with an emphasis in mining and exploration from the University of Arizona in 1984. I received an M.Sc. degree in Geological Engineering from the University of Arizona in 1987. I received a Ph.D. degree in Geological Engineering in 1990 from the University of Arizona. I served on the faculty of the University of Arizona from 1989 to 2017 and achieved the rank of Distinguished Professor in Mining and Geological Engineering. I served as the head of the department of Mining and Geological Engineering from 2000 through 2014. I co-founded and directed the interdisciplinary Lowell Institute for Mineral Resources at the University of Arizona from 2009 to 2017 and returned as co-chair of the board of directors and then co-director in 2017 and 2018 to present. I created and ran the Western Mining Health and Safety Training Resource Center from 2010 to 2017 with support from the U.S. National Institute for Occupational Safety and Health.

I have authored more than 100 research papers, conference papers, abstracts, and reports. I have managed or participated in more than $27 million of research funding. I have taught courses in mineral exploration, mineralogy and petrology for mining engineers, introduction to mining engineering, field methods in geophysical exploration, computer methods in geological engineering, mine surveying, sustainable resource development, earth resources and the environment, introduction to the global mining industry, and international mine safety and health laws. I have supervised the University of Arizona San Xavier Underground Mine.

I am a distinguished member of the Society of Mining, Metallurgy and Exploration and serve on the board of directors. I received the National Engineering Award from the American Association of Engineering Societies in 2017 and the Medal of Merit from the American Mining Hall of Fame in 2009. I received the Daniel C. Jackling Award from the Society of Mining, Metallurgy and Exploration in 2019. I serve as the executive editor of the research journal Mining, Metallurgy, and Exploration. I chaired the Mine Safety and Health Research Advisory Committee for the National Institute for Occupational Safety and Health. I have testified before Congress on workforce needs in mining and petroleum. I have served on four National Academies committees including serving as chair of the Committee on Earth Resources. My curriculum vitae is attached to this report as Exhibit A.

I am being compensated at a rate of $600 per hour for my expert work in this litigation.

III. TALC MINING

Talc is a secondary mineral formed by altering pre-existing minerals in place. Characterization of talc deposits is done with geologic mapping and drilling. [McCarthy et al., (2006), p. 976.] Talc bodies vary in size and shape and have been described as pipes [Downey Ex. 22], pods [JNJ 000088048; Downey Ex. 14, pp. 11, 22], and tabular (i.e. table like) bodies [Downey Ex. 14, pp. 10, 22]. The valuation of talc reserves is based on end-use requirements such as purity, brightness, particle shape, and accessory minerals.

A. Underground talc mining.

Historically, high-grade talc was mined underground, such as was done with the cosmetic talc sourced from Val Chisone, Italy and the Hammondsville mine in Vermont. In underground

mines, rock above the ore body is called the hanging wall and rock below is called the footwall. The portion of the ore body that is mined is called a stope. Horizontal or nearly horizontal underground openings are called drifts. A level is the system of horizontal underground workings connected to a shaft. The shaft is a vertical or inclined opening through which the mine is accessed [Hamrin (2001), p. 3]. Mining can be accomplished with drilling, blasting and transporting ore to the shaft or continuous mining machines can be used to eliminate the drilling and blasting cycle.

Operations at the Val Chisone, Italy mine used an underhand cut and fill mining method with cemented backfill [IMERYS 048837]. The Hammondsville, Vermont mine, when it was mined underground, has been described as a room and pillar mining method [IMERYS 048836]. Both mining methods are classified as selective mining methods [Hamrin, pp. 4-5].

1. Italy.

Cosmetic talc for Johnson's Baby Powder was from Italy from 1926 to 1966 with the exception of 1941-1946 when it partially or fully sourced from California. [JNJAZ55_0000000049-50; JNJTALC 000294523.] Production reverted back to the Italian source briefly in 1979, during a strike in Vermont. [JNJ 000085064.] Italian talc was mined from underground workings. The talc mines owned by the Societa Talco e Grafite Val Chisone in the Val Chisone region of Italy were described in a 1955 trip report prepared by the Battelle Memorial Institute. [JNJAZ55_000000597.]

W.L. Smith visited the Fontane mine in the Val Chisone region in Italy in 1959. [JNJ 000088048.] He collected 300 tons of high-grade talc for testing at Battelle Memorial Institute. Smith described the Fontane mine as having four horizontal openings from the mountainside entering the mountain to several thousand feet. The talc bodies were in pods with thicknesses of about 30 feet in parallel arrangement in a single irregular bed with dolomite marble. The footwall was mica schist and gneiss and the hanging wall was calcareous and micaceous schist. The dip ranged from 25 to 35 degrees into the mountain. High grade talc was being mined from the two upper levels. The ore was drilled and blasted, and high-grade talc rocks were sorted at the mine face and a second and third time at the mill.

2. Vermont.

When production began sourcing talc from Vermont in the 1960s, the Hammondsville mine, one of the first Vermont mines from which cosmetic talc for Johnson's Baby Powder and Shower to Shower was sourced, was an underground operation. [Downey Ex. 14, p. 7(JNJ 000245014).] The mine was closed in 1991. [IMERYS 117599.] The geology and ore reserve of the Hammondsville underground mine were described in a 1970 Colorado School of Mines Research Institute report [Downey Ex. 14] and an internal 1978 Windsor Minerals Inc. report [IMERYS 436972]. In 1970, there were two underground working levels, the 950 foot level and the 860 foot level from which stopes were worked from the bottom upwards.[2] The 950 and 860

[2] Levels in the mine refer to elevation above mean sea level so the larger level elevation numbers are closer to the surface.

foot levels were each more than 1,000 feet long in 1970. The ore deposits were described as tabular with a 20-degree dip [Downey Ex. 14, p. 10] and as much as 170 feet thick; the deposit became thinner and more tabular at depth, eventually pinching out about 2,000 feet down from the surface outcrop [Downey Ex. 14, p. 13.] By 1978 a fourth level, the 690 foot level, was in production and exploration was underway to explore below this level.

Initially, the underground mining methods at Hammondsville excavated development drifts that followed the edge of the talc ore body at the interface with the footwall. Similarly, development drifts at the top of the ore body followed the hanging wall. Traditional drill, blast and load techniques were used in underground mining in Vermont until the introduction of continuous mining machines (CMM) in 1973 at the Argonaut underground mine and 1982 at Hammondsville. [IMERYS 117599.] CMM allowed more selective mining. Pure talc is very soft, and the cutting head on the CMM could not cut the harder non-talc rocks. "*The mining machines are not able to cut the hard schists of the footwall and hanging wall and cannot in fact cut the harder low grade portions of the ore zones. This has become a very useful characteristic; for they therefore, have become automatic grade control devices. The rock the CMM's cannot cut, we cannot sell.*" [Miller, 1984, p. 3.] The CMM could stay in talc ore and away from non-talc dike material within 2.5 cm even as the dike material "*weaves and meanders through the mineable zone*." [Miller, 1984, p. 3.]

B. Surface talc mining.

Today, most talc deposits are mined in surface open pits. Selective mechanical surface mining uses small excavators such as hydraulic shovels (also known as backhoes), or wheel-loaders and small haul trucks. [McCarthy et al. (2006).] One of the differences between talc surface mining and surface mining for other minerals and rocks is that "*blasting is minimized to prevent the breakage of soft talc ore, and all shovel work is accompanied by a high level of selectivity to minimize contamination of high- and low-grade material*." [McCarthy et al., p. 976.] Softer rock can also be broken mechanically instead of by blasting and the Ludlow mines in Vermont (which include Argonaut) list hydraulic breaker attachments for the excavators [CYPRUS 02-15-18 00211, at p. ITA-Sabatelli-000559.]

1. <u>Vermont.</u>

The surface mines that supplied cosmetic-grade talc at various times include the Argonaut, Hamm, and Rainbow mines. Not all production from these mines met requirements for cosmetic-grade talc and some talc was sold for industrial applications. [Downey Ex. 24.]

The most important resource identified by Rio Tinto in their 1992 due diligence for the acquisition of talc assets from Cyprus Industrial Minerals was the Argonaut Main orebody and the Argonaut East orebody. [Downey Ex. 11, p. 34.] Drilling campaigns to define the Argonaut ore body were conducted at Argonaut in 1972, 1973, 1989, 1992, and 1998. Enough stripping was completed in 1994 to access the Argonaut East ore body. Ore was crushed at the Ludlow mill and stored in an ore shed before being transported to the West Windsor mill. Stockpiles were segregated by grade and properties. [Downey Ex. 24.] The Argonaut ore fed the Ludlow mill for industrial products and the West Windsor mill for cosmetic-grade talc product as well as

some industrial products like paint and plastics. [Downey Ex. 24.] The West Windsor mill was closed in 2003. [Downey Ex. 25.]

A MEDSYSTEM mine planning software package had been used from approximately 1992 to 1995 for the Argonaut ore body. MEDSYSTEM was the original name for MineSight (now called MinePlan by Hexagon AB, the current seller of the software). MineSight was one of the first comprehensive mine design, scheduling, and planning computer programs. Excel was used at Argonaut from 1995 to 1998. The TechBase software package was acquired in 1998. TechBase also has geology and drillhole tools as well as mine design packages. [Downey Ex. 24.]

Rio Tinto conducted due diligence on the Hamm mine as part of the Cyprus Industrial Minerals talc assets acquisition in May 1992. [IMERYS 238270.] At the time of the Rio Tinto acquisition in 1992, the Hamm mine was the largest producer of talc for Cyprus in Vermont. The ore at Hamm was classified in the mine computer model used by Cyprus as ore types 30 and 40, massive talc/carbonate “grit” containing 40-60% talc with 72-76% brightness and talc/carbonate schist (ore types 10 and 20) averaging more than 55% talc with lower brightness.

2. China.

Talc is sourced from a surface mine in the Guangxi Province, Longshen County in China for cosmetic applications, and since 2003 this has been the only source of cosmetic grade talc for Johnson’s Baby Powder. The mine is open pit, and mining is done with small mechanized equipment [IMERYS 415991]. The talc ore is hand sorted in several steps and analyzed for quality at Guangxi University [JNJI4T5_0000005147] before shipment to the processing facility in Houston, Texas. Hand sorting of high-grade talc is a technique that is also used in production outside of China. For example, the Three Springs talc mine in Australia, the largest talc mine in Australia, was hand sorting high-grade talc ore in 2005 [Noakes (2005)]; this mine was not a supplier for Johnson’s Baby Powder or Shower to Shower but was owned by Luzenac. Cook testified at his deposition that hand sorting is an effective step in beneficiation. [Cook Dep. 443:11-23, Jan. 30, 2019.] I agree that hand sorting is an effective and appropriate step in beneficiation of high purity ores such as cosmetic talc.

IV. METHODOLOGICAL FLAWS IN KREKELER AND COOK’S OPINIONS

I now address the opinions offered by Cook and Krekeler, which contain numerous methodological flaws and other errors, which I address under separate headings below. Both experts misapprehend or misapply basic geological and mineralogical principles; they make improper assumptions about the talc that was actually supplied for Johnson’s Baby Powder and Shower to Shower based on talc that was not used in those products (or mines that did not supply talc for those products); they base opinions on irrelevant test results and documents or misread or misconstrue those results and documents; they do not correctly describe the features and capabilities of certain mining techniques; and, they commit various additional methodological errors that I detail below. The net result of these flaws in their methods is that their opinions are entirely unreliable.

A. Cook and Krekeler improperly conflate non-ore samples with ore samples.

First, Cook and Krekeler ignore the fact that analyses of specimens from mines in Italy and Vermont that they cite as having asbestiform minerals are from non-ore specimens. Non-ore signifies material that would not have originated in the location within the mineral deposit where talc that went into product was mined. As such, the contents of non-ore specimens cannot support a conclusion about what would be found in talc used in Johnson's Baby Powder or Shower to Shower.

For example, Cook states: "*Mineralogical work on Italian talc was conducted in the 1970's by University College in Cardiff, Wales. This research identified the presence of both tremolite and actinolite in associated rocks. These minerals were fibrous in some cases (JNJ_00030983; JNJ 000016791; JNJ 000060592; JNJ 000238194; and JNJ 000322351).*" [Cook Report, p. 10.] As described below, none of these samples actually came from the talc ore. [Cook Report, p. 10.]

Several of the documents Cook relies on do not support or even relate to his proposition. JNJ000016791 involves neither work by the University of Cardiff nor testing for asbestiform minerals. JNJ_000030983 and JNJ000016791 are different copies of the same paper, which does not appear to involve studies of Italian talc by the University of Cardiff. JNJ 000238194 is a worldwide talc survey that actually lists Italy as an area of maximum confidence and does not reference work by the University of Cardiff, tremolite or actinolite.

And, in fact, the referenced report by researchers at University College, Cardiff, U.K. described a study of talc rock samples [JNJ 000322351] that were not ore. The report clarifies that the samples "***do not represent an average collection of specimens of material being produced at the mine. The specimens were collected with the intention of sampling those areas with obvious non-talc mineral inclusions***." [JNJ 000322354.] These tests were conducted not to characterize the ore that was being processed and used in products, but to describe the impurities that were not in the ore material. A company would test material that is not going to be processed as a risk management step to understand the nature of the mineralization in the mineral deposit. For example, samples B1-B9 were collected to sample a pure talc face (B1 and B8), a green talc (B2) and grey talc (B9) and to test the change in mineralogy from the footwall (B3) and around an inclusion (B4-B7). Sample I.39 was from the crusher and had no asbestiform minerals. Sample I.41 was labeled as a "*good specimen from face 2*" and had tremolite only as an inclusion in a garnet mineral grain. Such a study of non-ore areas within the mine indicates that surrounding waste rock was mapped in a responsible manner.

The report makes clear that no asbestiform minerals were found and any non-asbestiform amphiboles identified were not located in ore typical of production. Some specimens were collected in the hanging and footwall but "***the method of mining which consisted of hand filling methods precluded any gross contamination of the ore***." [JNJ 000322354.] The report describes the tremolite minerals as occurring in inclusions in the talc with a composition similar to the footwall. These carbonate inclusions were "*large and very discrete in the talc seam*." [JNJ 000322474.] The study concluded that while tremolite was rare in the carbonate specimens, "***no tremolite was detected in the talc-type specimens***." Tremolite was extracted from samples I.19 and I.20 and the crushed minerals were found to be stubby rather than asbestiform. Neither

specimen was described as being from ore. The report further states: "*Both lath and textile types of particles were not composed of minerals associated with the commercial asbestos industry. **Particles formed from the amphibole mineral found at the mine were hardly fibrous in character**, the majority of the tremolite breaking to give compact particles. . . . No amphibole or chrysotile mineral was detected in any of the numerous powders examined.*" [JNJ 000322475.]

B. Cook and Krekeler improperly conflate non-asbestiform minerals with asbestiform minerals.

Cook and Krekeler conflate the mineralogy of asbestiform and non-asbestiform minerals by repeatedly citing the presence of non-asbestiform mineral varieties of amphibole and serpentine as being asbestos. For example, Cook and Krekeler each cite Battelle Memorial Institute reports from the 1950s. Battelle conducted tests on cosmetic talc samples from Italy in 1957 through 1959. [JNJ000087868; JNJ000087231; JNJ000087166.] Trace amounts of tremolite were identified, but the tremolite was not identified as asbestiform.

In fact, a February 1975 document [JNJ000238194] cited by Cook rated Italian talc, Grade SVC Extra 00000 supplied by Societa Talco e Grafite, Val Chisone, Pinerolo, Italy as the maximum confidence of quality. The report also listed Vermont talc as high confidence. Additionally, an April 30, 1973 memo from Dr. Umberto Stefano, M.D. [JNJ000270588] references a study on whether talc mining in the Val Chisone region caused lung diseases in mine and mill workers due to the presence of asbestiform minerals and silica. He interviewed doctors in the area, and they were unanimous that they had not observed any malignant tumors of the lung related to asbestiform minerals in talc miners who were their patients. Dr. Stefano's study was followed by a 2003 article in the American Journal of Industrial Medicine focused on a cohort of 1,795 talc miners and millers in Val Chisone [Coggiola et al., 2003]. The 2003 study stated that there were **no asbestiform fibers in talc from the Val Chisone region**. Another study in 2017 in JOEM [Pira et al., 2017] examined a cohort of miners and millers from Val Chisone specifically to look at exposure to **asbestos-free talc**.

C. Cook and Krekeler improperly extrapolate from the general mineralogy from different regions to opine on the exact mineralogy of ore that went into Johnson's Baby Powder or Shower to Shower.

Cook cites studies and literature about regional and district-scale geology that is not specific to talc mined for Johnson's Baby Powder or Shower to Shower. As a general matter, talc ore bodies are often mineralogically distinct from the rocks surrounding them. Guilbert and Park explain this distinction in terms of the roles of fluids, temperatures, pressures, mineral zonation, changing sequence of mineralization, and structural controls on the small to large scale differences in mineralization and mineral texture in mineral deposits. They note that some ore deposits formed by regional metamorphism "*involve local centimeter-to-meter scale redistribution of mineral components by the chemical mobility induced by higher temperatures and pressures, probably in the presence of pore water; new metamorphic rocks and minerals such as garnets are formed*." [Guilbert and Park (1986), p. 844.] **The geologic conditions that combine to make the rare occurrence of an ore deposit means that the ore deposit has distinct properties from the surrounding rocks and cannot be generalized.**

Cook states "*Chrysotile is also reported in the Val Chisone mineral suite in 1971 by Ashton (JNJAZ55-000006103).*" [Cook Report, p. 10.] The reference cited by Cook (JNJAZ55-000006103) is a letter informing the Colorado School of Mines Research Institute that samples are being shipped from Italy for them to test. The letter does not state that chrysotile exists in Val Chisone talc sourced for Johnson's Baby Powder or Shower to Shower and does not mention the Fontane Mine. The letter simply states that chrysotile exists in the general region of Val Chisone. Furthermore, previously cited medical studies by Coggiola et al., (2003) and Pira et al. (2017) state that asbestos did not exist in the Val Chisone talc ores to which miners and millers were exposed. And the previously discussed report on the Italian mine from the University of Cardiff clarifies that the talc ore was free of asbestiform minerals.

Cook also misrepresents general information on minerals associated with talc in Italy [IMERYS 081025] as confirmation that asbestiform mineral varieties were present in Italian talc used in Johnson's Baby Powder and Shower to Shower. The information in IMERYS 081025 was general information found in such references as the Industrial Minerals and Rocks Handbook, Kogel et al., (2006), and was not specific to cosmetic talc used in Johnson's Baby Powder or Shower to Shower.

D. Cook improperly conflates the mineralogy of non-cosmetic grade talc mines with cosmetic grade ore that went into Johnson's Baby Powder or Shower to Shower.

Cook writes the following: "*Based on the mineralogy of Vermont talc deposits, the potential for asbestos to be present in J&J's talcum powder products was significant. Potentially asbestiform amphiboles such as actinolite, tremolite, anthophyllite, and cummingtonite are reported from a variety of Vermont talc-related serpentinite localities. These include the Carlton talc mine in Chester, Windsor County and other Vermont serpentinite-related actinolite or tremolite occurrences as documented by Seymour (J&J 0053200) at Hammondsville, the Barton steatite quarry, Holden talc quarry, Rochester verde antique quarry, and the Mad River mine.*" [Cook Report, p. 11.] These observations are irrelevant because they concern the wrong mines and/or mischaracterize the findings concerning amphibole minerals.

Except for Hammondsville, none of the locations referenced by Cook were a source for cosmetic-grade talc used in Johnson's Baby Powder or Shower to Shower [JNJTALC000168988; JNJ 000404692; JNJ000314938; JNJTALC000239225; JNJTALC000348610;IMERYS 225714.] And as for Hammondsville, the graduate thesis [J&J 0053200] by Seymour does not identify asbestiform mineral varieties, and this thesis was focused on the Johnson mine, which was never a source of cosmetic grade talc for Johnson's Baby Powder or Shower to Shower.

As previously noted, ore deposits have unique mineralization from the surrounding country rocks, which is what distinguishes them as economic deposits of minerals. The general mineralogy of a region cannot be localized to the specific mining zones within an ore body. For example, Guilbert and Park note the role of stress in changing the distribution of mineralization in mineral deposits and how the permeability and porosity created by fractures and joints at the large scale and crystal boundaries and cleavage planes at the small scale contribute to the "***final configuration of ore-deposit components***." [pp. 66-67.] Evans also notes the changes in

mineralization over a small scale in metamorphic ore deposits [(1996) p. 69], which further support the fact that mineralogy cannot be specifically extrapolated from a regional scale to an ore zone scale. Both references note the highly localized nature of mineralization in ore deposits relative to regional geology.

E. Krekeler improperly cites data regarding regions in China where talc was never sourced for Johnson's Baby Powder or Shower to Shower to opine that the specific Chinese ore body sourced for Johnson's Baby Powder or Shower to Shower was contaminated with asbestos.

Talc sourced in China for Johnson's Baby Powder and Shower to Shower comes from a mine in the Guangxi Province. [JNJMC 000100913.] However, in his report, Krekeler cites the presence of asbestos in China "*in fractures of the talc ore body of the Maanshan Talc deposit located in the Shanglin region. IMERYS 413792.*" [Krekeler Report, p. 12.] The Maanshan deposit was not a source of talc for Johnson's Baby Powder or Shower to Shower. [JNJMC 000100913]

Krekeler further conflates other mines in China with the sources of talc for Johnson's Baby Powder and Shower to Shower; he states the following: "*Notably, the Shandong Province was also associated with amphibole grade morphisms. Therefore, Johnson & Johnson and Imerys had information regarding tremolite's presence in the region and could be reasonably anticipated to be present in the ore used in talcum powder products.*" [Krekeler Report, p. 11.] Talc that goes into Johnson's Baby Powder and Shower to Shower, however, is not sourced from the Shandong Province, which is, in fact thousands of kilometers away from the applicable mine.

F. Cook and Krekeler rely on irrelevant test results for their opinions that Johnson's Baby Powder and Shower to Shower were contaminated with asbestos.

Cook and Krekeler both rely on test results analyzing talc sourced from mines that never produced cosmetic grade talc for Johnson's Baby Powder or Shower to Shower. For example:

- Cook and Krekeler rely on several samples labeled as WMI in which McCrone laboratory detected chrysotile in 1985 and 1986. [JNJMX68_00013019; Hopkins Dep. Ex. J&J 182.] The samples were from the Red Hill mine in San Andreas, California, a mine from which cosmetic talc was never sourced for Johnson's Baby Powder or Shower to Shower. [JNJ 000065646; JNJ 000578888; IMERYS 013723.]

- Cook and Krekeler rely on testing by The Colorado School of Mines Research Institute on split core samples from a Vermont exploration program in February 1976. [Hopkins Dep. Ex. J&J 100.] Trace amounts of tremolite-actinolite and anthophyllite were detected in 3 samples. The samples were from north of the Frostbite mine [JNJ 000682638], which never produced talc that went into Johnson's Baby Powder or Shower to Shower.

- Cook and Krekeler rely on the testing and characterization of sample FD-14 to suggest that cosmetic talc sourced for Johnson's Baby Powder and Shower to Shower

was contaminated with tremolite asbestos. [JNJ 000238826; JNJ 000248023.] Sample FD-14 is from the Gouverneur mine in New York, which was never a source of cosmetic talc for Johnson's Baby Powder or Shower to Shower.

Cook and Krekeler also rely on test results involving industrial grade talc, which did not go into cosmetic products. For example:

- Cook and Krekeler rely on a test result for sample D-GI from McCrone laboratory. [Hopkins Dep. Ex. J&J-74.] The sample was found to have chrysotile. The sample is from Gassetts mill, which did not process cosmetic talc that went into Johnson's Baby Powder or Shower to Shower. [JNJMX68_000002659.]

- Cook and Krekeler rely on a 1975 testing report for Vermont talc [JNJNL61_00027053] that pertains to Grade 36 talc. Grade 36 talc was non-cosmetic talc produced from the Argonaut mine [IMERYS 013723].

Moreover, Cook and Krekeler rely on preliminary test results to conclude asbestos was present in talc ore sourced for Johnson's Baby Powder and Shower to Shower. For example:

- Cook [p. 14] and Krekeler [p. 15], cite a 1971 Colorado School of Mines Research Institute test on sample 344-L and six monthly Vermont talc samples, finding tremolite-actinolite in several as proof of "*Presence of Asbestos in Defendants' Talc Ore.*" [Hopkins Dep. Ex. J&J-15.] Both fail to note that the Colorado School of Mines retracted their findings, noting that the room in which the samples had been prepared was contaminated with asbestos. When re-tested, no asbestiform minerals were found in any of the samples. [JNJAZ55_000003828.]

- Cook [p. 14] and Krekeler [p. 17], rely on preliminary testing results from Dr. Lewin as further proof of asbestos in Johnson's Baby Powder or Shower to Shower. In these preliminary results, Lewin reported potential asbestos in various product samples, specifically 5% chrysotile in sample 84 (Shower to Shower), 2% chrysotile in sample 133 (Johnson's Baby Powder) and 3% chrysotile in sample 134 (Johnson's Baby Powder). [Hopkins Dep. Ex. J&J-28; Hopkins Dep. Ex. J&J-30.] While Dr. Lewin writes that he is submitting his "*final analytical results*", subsequent testing was in fact done by both Dr. Lewin and the FDA. [J&J-28.] Neither Lewin nor the FDA reported chrysotile or any other potential asbestiform mineral in any of the Johnson's Baby Powder or Shower to Shower samples. [DX 7113.]

Consequently, as both Cook and Krekeler's opinions are founded on review of these irrelevant or incorrect sample testing results, their overall conclusions are not scientifically valid or even relevant.

G. Cook relies on test results that postdate production for cosmetic talc at the Argonaut mine, which cannot be extrapolated to ore sourced from earlier sections of the mine because mines are continually in development.

Cook misrepresents the arsenic content of talc ore for cosmetic applications in that the arsenic-bearing talc that they address was not being used for cosmetic products. Cook cites a 2006 report [IMERYS-A_0002017] on the potential presence of arsenic in the Argonaut mine as evidence that there was arsenic in Johnson's Baby Powder and Shower to Shower. [Cook Report, p. 30.] But in 2006, no Vermont talc was being supplied for use in Johnson's Baby Powder or Shower to Shower. [IMERYS-A_0015174.] This is important because mining takes place in stages through the life of the mine and areas being mined in 2006 were not necessarily being mined in 2003 or 1995, because not all overburden and uneconomic rock is stripped at the start of mine production. That is, during the life of a mine, ore is taken from different parts of the deposit, and ore from one area of a deposit is not necessarily homogeneous with ore taken from a different area.

Cook cites a 2008 Rio Tinto ore reserve report as evidence that the Argonaut talc ore has 4% chlorite and therefore posed a risk for heavy metal contamination. But again, Argonaut was not supplying talc for Johnson's Baby Powder or Shower to Shower in 2008. And in any event, Rio Tinto was coding the chlorite zones as part of the ore reserve modeling process that involved quantifying waste material that would not be processed. [Cook Report, pp. 7-8; IMERYS 441340.]

Cook relies on IMERYS 132823 to support his opinion that "*[s]erpentine and arsenic occurred near the edges of the ore zone and ore quality control by segregation at the mine site was inadequate (IMERYS 132823 at 825).*" [Cook Report, p. 38.] The document he cites [IMERYS 132823] is a 2006 memo regarding arsenic at Argonaut, but Argonaut was no longer a source of talc for Johnson's Baby Powder or Shower to Shower in 2006. Arsenic was a concern at the Ludlow mines in 1992, and selective mining was employed to control arsenic levels. Cyprus Industrial Minerals noted that an arsenic-bearing mineral, Pitticite, had been associated with oxidized joint systems and was being selectively sorted to avoid sending those rocks to the mill. [IMERYS 340093.]

In short, Cook's opinions on arsenic lack any connection with Johnson's Baby Powder or Shower to Shower because the are premised on documents addressing the potential presence of arsenic in the Argonaut mine during periods when talc for these products were not sourced from that mine.

H. Cook and Krekeler's opinions regarding inadequate sampling are premised on misrepresentations of documents and sampling theory and lack evidentiary support.

1. <u>Cook and Krekeler misrepresent the documents cited in support of their sampling opinions.</u>

Krekeler improperly relies on a 2007 "Field Trip Report on the Talc Mining and Prospect Areas in Hubei, Guangxi and Shandong Provinces, China" to opine that insufficient assessment

was conducted on the ore sourced for Johnson's Baby Powder. Specifically, Krekeler states the following: "*Additionally, only eight samples were taken during the entire trip to China (IMERYS 416007), one of which was identified as containing intergrown bladed tremolite. Considering the trip was for basic assessment and that multiple properties and locations were visited, I would expect much more sampling – in the range of 100 to 150 samples – to occur to give a crude assessment of quality. This lack of sampling suggests a general lack of rigor in assessment, economically and operationally. In the report's conclusion, there is no mention of the need to screen or plan a protocol or procedure for the prevention of tremolite or other asbestos contamination (IMERYS 416007).*" [Krekeler Report, pp. 11-12.]

Krekeler is in error by using the trip report to conclude there was a lack of rigor in assessing the quality of talc sourced in China. The purpose of the trip was not to conduct a complete assessment of the specific Chinese ore in use but rather to assess various regions on a broadscale and evaluate prospect areas. The author, David Crouse, clearly states in the opening paragraph of this trip report: "*The purpose of this trip was both to review the geology of the major talc districts in Guangxi and Shandong as well as to evaluate potential prospect areas in those regions and in Hubei. This report is a summary of that trip with recommendations and opportunities identified*." [IMERYS 415992.] The purpose of trip was to see if there were more talc deposits that Rio Tinto should explore or to look for an acquisition of a company or a joint venture. Crouse visited 4 mines in Guangxi Province and recommended exploration of the Dadi license area. He collected 8 samples to illustrate variations in the geology of each mine he visited. The sample with "*intergrown bladed tremolite*" is labeled Liboshikuang #3 from the Liboshikuang mine, which has never produced cosmetic talc for Johnson's Baby Powder or Shower to Shower. [IMERYS 416007.]

Additionally, Krekeler relies on selective portions of [IMERYS 09371] in forming his opinion that composite sampling was ineffective for quality control. On page 41 of his report, he supplies a block quote from an audit finding, rated "minor": *"Samples for the incoming raw material are taken from the large rocks and are not representative for the incoming raw material lot. A large rock from the shipment is milled and made into composites for USP/EP/FCC testing. A more representative sampling would be to take not only [one] large rock but smaller rocks from different parts of the shipment and create a composite sample for testing."* Krekler fails to acknowledge the audit response two paragraphs below: *"There may have been some misunderstanding on this. Actually, a group of different sized rocks is obtained from the incoming truckloads and is used to form the composite sample that is representative of the entire shipment. The large rocks tend to be purer talc but the smaller sized rocks and dust are also obtained for the composite"* [*Id.*]

Likewise, Cook states, without evidence, that there is a lack of data to support the robust sampling protocols required for Johnson's Baby Powder and Shower to Shower. Cook cites two documents that lay out the rigorous asbestos testing protocol required for Johnson's Baby Powder and Shower to Shower, but concludes that no data indicate that these protocols were followed: "*Incomplete data indicate that weekly composited flash dried talc samples were collected for J&J for asbestos analysis [IMERYS 139093 at 094; JNJ 000252225 at 226]. A precise plan was presented for the West Windsor plant by Cyprus in 1992 that would have resulted in many hundreds of arsenic analyses per year [IMERYS 054579]. Sampling protocols for ore and at many points along the processing line are described for the Windsor Minerals*

plant in 1988 [IMERYS 336098 at 147). However, there are no data to indicate that these aggressive plans were ever implemented." [Cook Report, p. 36.]

The documents that Cook cites do not support his contentions. For example, IMERYS 139093 states that the applicable testing protocols surpass industry standards. Biweekly composites of ground ore were tested by TM 7024, a transmission electron microscopy testing method. [JNJNL61_000005032.] Weekly composites of flash dried talc were tested by CTFA J4-1 and TM 7019, tests for fibrous amphibole and serpentine minerals, respectively. The requirement for all tests was "none detected." Additionally, JNJ 00025225 states that bi-weekly composite samples of Raymond grind were tested by TM 7024, weekly composite samples of flash-dried talc were tested by CTFA J4-1 and TM 7019 and finished talc was tested on a quarterly audit basis by TM 7024.

Cook cites JNJ 000252225 as further evidence of sampling errors when he states: "*Incomplete data indicate that weekly composited flash dried talc samples were collected for J&J for asbestos analysis.*" [Cook report, p. 38.] This is a June 28, 1977 document formalizing the testing for asbestos in Grade 66 talc from Windsor Minerals. Bi-weekly samples were taken from the Raymond milling machine using TM 7024 as the test standard; flash dried talc is tested with a weekly composite using CTFA J4-1 and TM 7019 and finished talc is tested using TM 7024 with quarterly audits of random samples. There is no evidence in this document that sampling frequency was problematic and the document does not support Cook's claim.

Indeed, these documents do not support Cook's claim that sampling frequency was inadequate to ensure a talc product that met applicable standards. Instead, these documents support the exact opposite proposition. The fact that Cook has not seen the complete universe of testing results does not amount to evidence that formal testing protocols were not followed. Notably, McCrone Associates, Inc., an independent lab that did testing of Johnson's Baby Powder, wrote in 1987: "*Our first project with Windsor [Minerals] was opened in September 1971. Since that date we have continuously monitored composite samples for Windsor using transmission electron microscopy, the most sensitive technique for fine asbestos fibers.*" [JNJMX68_000015726.] The document goes on to note that McCrone has been of the opinion that "*Windsor's product is free of asbestos*" for over 15 years. [JNJMX68_000015726.]

Additionally, Downey Ex. 64 is a 2001 document summarizing asbestos testing at talc mines in North America. The document states the following in reference to the Argonaut pit: "***Out of hundreds of such samples****, on one occasion, Bain reported detection of chrysotile fibers in a Windsor Feed sample. A retest, on a duplicate, sealed sample, failed to confirm the finding.*"

2. Krekeler incorrectly represents sampling theory used in mining as an example of "*Specific Failures to Properly Sample Materials*."

Krekeler states that "*[c]omposite sampling is a flawed methodology to adequately monitor for asbestos and toxic metals and should be reserved for products not intended for human consumption or cosmetic use.*" [Krekeler Report, p. 41-42.] He cites Afewu and Lewis (1998) to justify this claim. The Afewu and Lewis paper, however, is in reference to sampling broken ores, specifically gold. Essentially this paper and previous work by Pierre Gy on sampling theory establish that there must be a correlation between the sample mass and the

maximum particle size. Reducing sampling error was traditionally achieved by collecting larger samples. The belief was that sampling variance was inversely proportional to sample mass. This belief was justified by the assumption that binomial (random process) statistics could be applied to sampling an ideal, synthetic model of a geological material that assumed the material consisted of particles that were all the same size and shape and each was of constant composition (equant grain model or EGM). Real geological materials are not particulate shaped in nature, do not consist of grains of the same size, shape, and composition, and are not fully separated into ore and gangue. [Stanley (2007), pp. 109-110.]

Stanley's model, based on first principles of calculus and statistics, proves the relationship between sample mass and sample variance must account for particle size in the sample. The smaller the particle size, the smaller the sample mass required to reduce the sampling variance. Because composite samples of ground talc consist of small particles, the size of the composite samples is sufficient to conduct appropriate quality control.

Sampling theory in exploration geology, mining, and metallurgy are important but complex topics, and there is no settled method that is absolutely correct for all situations. A keyword search for "sampling" in the OneMine.org database of worldwide professional publications related to mining, geology, and metallurgy returns more than 12,000 articles. Post Rademacher, and Hill summarize sampling for industrial minerals as highly specialized and explain that "*preparation and testing procedures are end-product sensitive; that is, the preparation and testing procedures to be used are controlled by the properties desired in the final product.*" [Post et al. (2011), p. 187.] They further caution that "*no specific guidelines can be given . . . other than to suggest that sample preparation and testing procedures be established for individual deposits through frequent and close communicaiton among exploration and mining staff, laboratory personnel, mill managers, marketing staff, and end users.*" [p. 187.]

On page 43 of his report, Krekeler further and incorrectly opines that the use of composite sampling makes it impossible to effectively monitor for asbestos and heavy metals. Noble addresses the importance of compositing in mineral resource calculations. "*Compositing is a procedure used in developing resource estimates in which sample assay data are combined by computing a weighted average over longer intervals to provide a smaller number of data with greater length. Compositing is usually a length-weighted average*." [Noble (2011), p. 206.] Compositing is done for geologic modeling because it makes geostatistical analyses more accurate and incorporates dilution into the model calculations.

"*Where the drill holes are drilled in many directions with respect to the ore zone, the composite length may need to be varied based on the orientation of the drill relative to the ore zone. For example, when mineralization in a tabular structure has much better continuity along the structure than across the structure, drill holes oriented perpendicular to the structure should be composited to a short interval, while drill holes oriented parallel to the mineralization should be composited to a longer interval. The ratio of the length of the composites should respect the relative continuity of mineralization in each direction.*" [Noble, p. 206.]

Downey Ex. 48 illustrates the schematic diagram for the West Windsor mill [IMERYS308392, p. 9], with the sampling points described in Downey Ex. 50. The talc ore is first sampled after being crushed and screened. The next sampling point is at the grinding mills

to test the float feed, followed by the concentrate from each stage of the flotation process and the corresponding tails. Next, filter cake is sampled after the thickening and filtering stage, then samples are taken at the flash dryers to test for microbial content. Downey Ex. 51 describes the silo sampling. Downey Ex. 58 describes the sampling and testing frequency. The many sampling points and frequent sampling throughout each shift allow the test results to be tracked over time and correlated with the ore being processed which ultimately tracks back to the blocks in the mine model.

The sampling methods described by these documents conform to Spedden's description of systematic sampling [Spedden, 1985, pg. 30-9]. Systematic sampling is sampling that is time-controlled in contrast to weight controlled or random and is used when the rate of material flow is constant as is the case with a mill. The silos appear to use weight controlled or stratified sampling where the sampling increment is based on filling a particular sized container or bag which is equivalent to weight sampling. This is a valid form of sampling when the tonnage rate is irregular such as the time period of filling a silo. A third form of sampling at West Windsor was grab samples which Spedden classifies as random-start sampling, which is used when quality parameters could be periodic, such as with ore from different parts of the mine being processed.

Sampling, particularly by compositing, is an essential part of building geologic models of an ore body, calculating reserves, creating the block model that informs the mine plan and providing guidance on selective mining.

Krekeler also incorrectly notes that "*[b]lending additionally makes traceability from product to lot to origin in the mine impossible.*" [Krekeler Report, p. 42.] Effective quality control measures were implemented, audited, and improved throughout the productive history of the mines and mills in Vermont [IMERYS 139093; JNJ 000252225; Downey Ex. 58; IMERYS 053275; JNJI4T5_000005163], and there is ample evidence that the sampling protocols in place were robust and effective. Several documents refute Krekeler's claim.

Downey Ex. 54 is a memo dated November 14, 1978 that outlines sampling for asbestiform mineral varieties. A memo reporting pre-1975 test data from Windsor Minerals Inc. stated that, with "*greater than 99.9% certainty, ores and materials produced from the ores at all Windsor Minerals locations are free from asbestos or asbestiform material.*" The memo stated that with the sampling program samples could **confidently be traced back to the source** in the Hammondsville mine.

IMERYS 427164 from 1997 documents that Argonaut was implementing a plan to track ore composition from blasthole assays to the mill and there were plans for close communication on quality control. In a document describing the 1999 Argonaut mine plan, the traceability of ore from the mine to the mill is described in terms of the segregation of stockpiles in storage. Each type of ore is stored in a different location. The block model allows the mine to know when each 10 foot cube of rock was mined, what type of ore it was, and where it was stored. The mine also used the block model to track the waste rock. [IMERYS 499021.]

Sampling protocol is further described in an April 2, 2001 report. [Downey Ex 56.] The Argonaut mine feed was sampled monthly for asbestos analysis. Each monthly sample was a composite of daily samples from 3-8 hour samples taken from an automatic sampler of roller

mill feed to the flotation circuit. These samples were analyzed at Bain Environmental. At the time of this memo the feed for West Windsor was coming from the south end of Argonaut Main, but at times it was blended with ore from Argonaut North. Each quarter a composite of the silo samples was sent to Bain for TEM analysis to confirm the results. No asbestiform had been detected at the time of the memo.

I. Cook and Krekeler incorrectly assert that selective mining was impossible, make improper assumptions about how drill campaigns must be conducted, misstate facts regarding mine planning and rely on incomplete data to opine that quality control was ineffective.

Cook states that, "*[b]ecause of the variability of the ore, it would be impossible to mine these talc ores underground without incorporating at least some host rock or lower grade ore, each potentially containing carcinogens such as asbestos and/or excessively high levels of certain heavy metals.*" [Cook Report, p. 7.] This, however, misrepresents that selective mining used at the Hammondsville mine was incapable of preventing contaminants from entering products. In fact, there is ample evidence that selective mining at Hammondsville was informed and effective.

At the Hammondsville underground mine, a chloritic biotite schist, locally known as "blackwall" or "black," was visually distinctive and marked the edge of the ore body and was the marker used for selective mining underground. "*The blackwall schist is used as a stratigraphic marker in mining to determine the location of the edge of the ore zone. It varies in thickness from a few inches to a few feet. Where the talc pinches out between ore lenses on the 860 Level, a thin layer of the blackwall can be followed from one lens to the next. This contact should be traceable for some distance from the mine, stratigraphically, and should aid in exploration*." [Downey Ex. 14, p. 10 (JNJ 000246017).]

The rock locally knows as "verde antique," meaning serpentine, did not in fact contain serpentine [Downey Ex. 14, p. 11 (JNJ 000245018)], and therefore no asbestiform mineral varieties associated with serpentine. This verde antique material was interpreted as the core of the ore body and occurred as a definite horizon in the cross sections that was recognizable to miners and could be avoided with selective mining. "*The latter term [verde antique], although somewhat a misnomer, is used in this report as it describes the physical appearance of the rock quite well*." [Downey Ex. 14, p. 11 (JNJ 000245018).]

In addition, drill data from the Hammondsville underground mine indicate that effective selective mining was used and that 40-50% of the talc ore was left behind to ensure waste material was not sent to the mill. [Downey Exs. 14, 15, 16.] Colorado School of Mines Research Institute (CSMRI) in 1970 conducted an assessment of the geology and ore reserved of the Hammondsville mine based on 40 drill holes. [Downey Ex. 14, p. 25 (JNJ000245032).] 107 samples were sawn from cores from 17 drill holes for chemical, mineralogical and petrographic analyses and a subset of these samples were further examined after flotation. 40 samples of core were analyzed as thin sections and no asbestos was found. Tremolite-actinolite was identified in interval 57.3 to 59.3 feet in drill hole 1-67-H using XRD; this sample is in the "blackwall" which is **not ore**. DH 36-67-H had small amounts of tremolite-actinolite in interval 548-553 feet; this is in a quartz biotite schist which is **not ore**. DH 45-67-H detected actinolite-tremolite in interval

903-905 ft. DH 49-68-H showed actinolite-tremolite in interval 973-976.5 feet; this is in a chlorite schist which is **not ore**. The CSMRI report recommended further drilling to refine the ore deposit model. The recommended holes were to be placed to fill in missing questions about size and quality of the ore body.

Per the 1970 CSMRI recommendations, a diamond drilling campaign was conducted in 1976 and 1977 to further the understanding of the resources and reserves available at the mine. [IMERYS 436972.] The 1978 report [IMERYS 436972] illustrates how knowledge of the orebody improved over time, as is typical for a mine in development. This period pre-dates use of computer models for ore reserve estimation so effective methods typical for the period were used – triangular methods and isopach maps for thicknesses (*see* Figure 1a,b). The triangles were constructed to respect the boundaries of the footwall on each level and thus avoid mining gangue and diluting the ore.

Plate 1 - Talc Thickness Contours (isopach map)

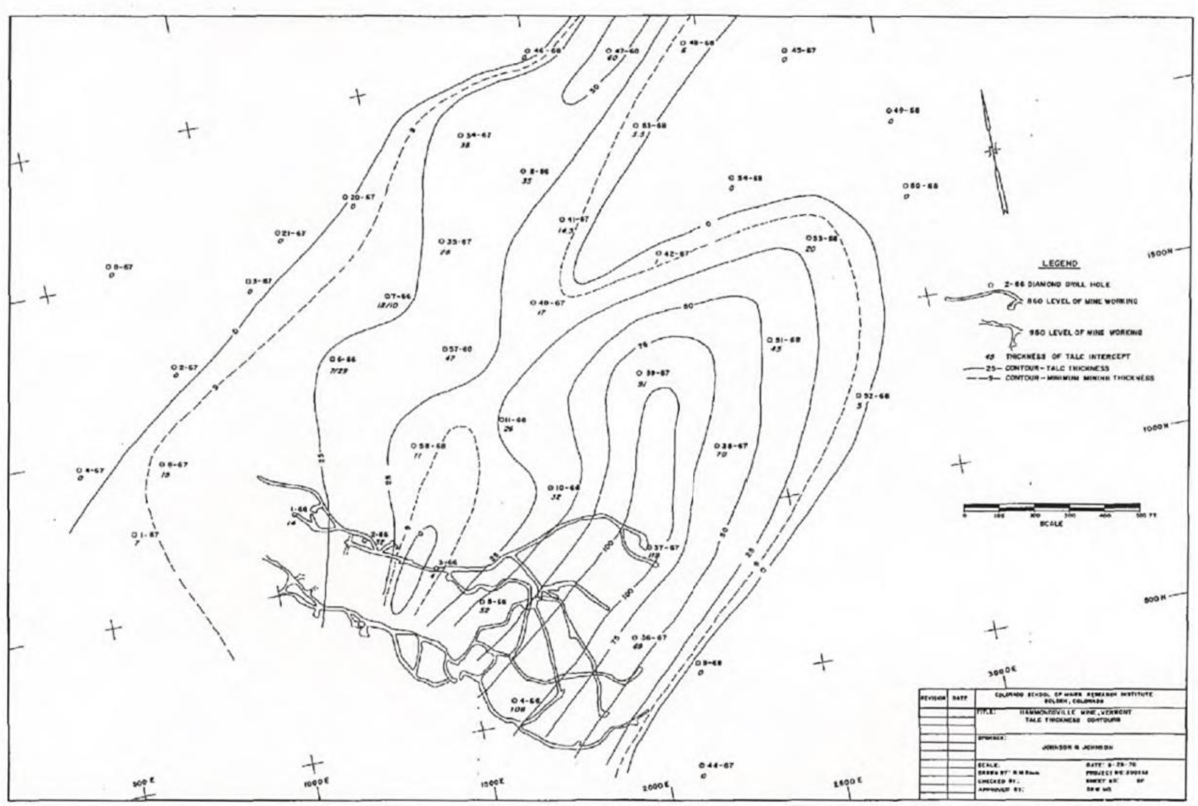

***Figure 1a**. Talc thickness, "isopach" contour map for the Hammondsville mine in 1970. [Downey Ex. 14, pp. 13-14.] The thicknesses are derived from drill hole logs and used to estimate volumes from the triangle or polygon maps in Figure 1b.*

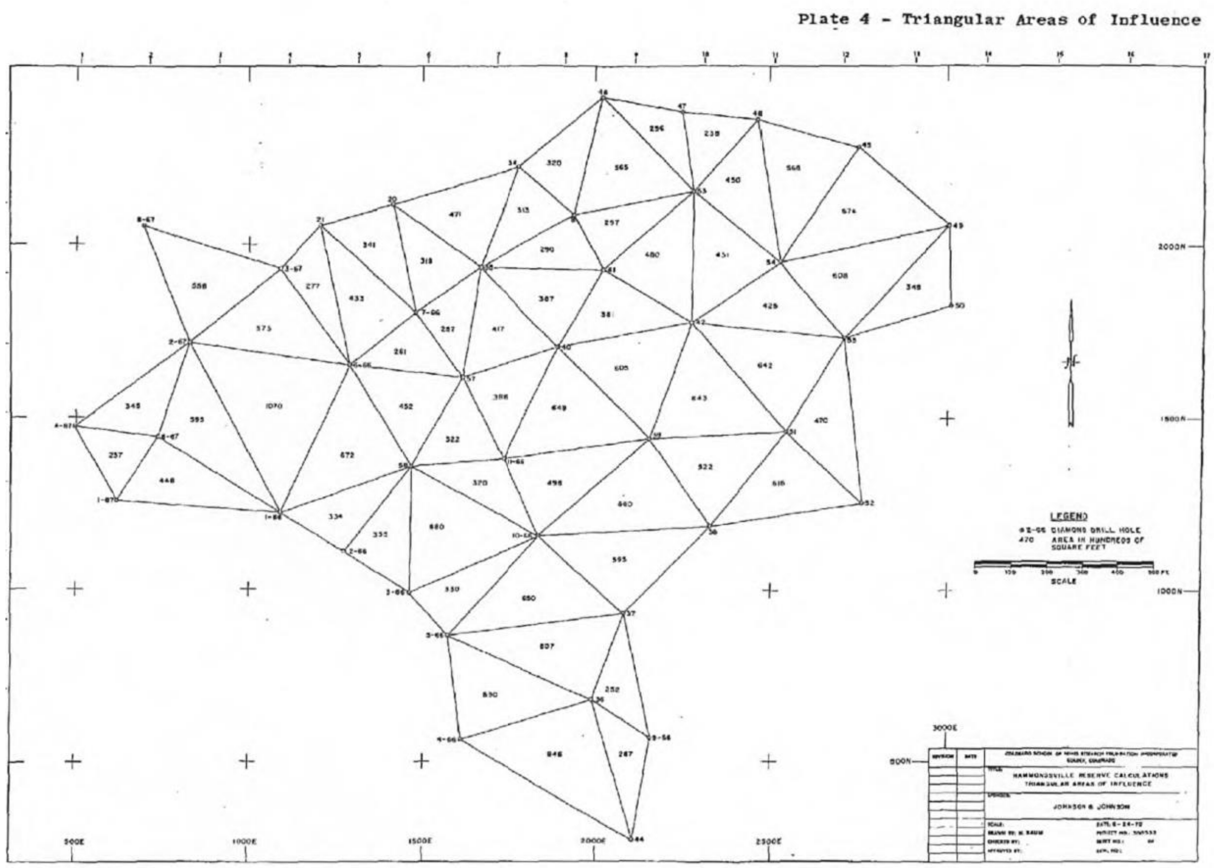

Figure 1b*. Area of influence diagram for the Hammondsville mine in 1970. Such diagrams are used to assign ore grades to volumes of rock using the isopach contour map in Figure 1a. [Downey Ex. 14, p. 27.]*

Evidence of the care given to selective mining is present in the statement: "***Careful attention was given to the waste zone between the main ore body and the shaft section. Our knowledge of the geologic structure indicates that triangular sections should neither cross nor enter this zone*** . . . " [Downey Ex. 15, p. 4 (IMERYS 436979).]

Downey Ex. 16 shows mine maps for Hammondsville with drill holes plotted. The holes are largely on a grid and page 10 shows an example of how the drill holes are located to add information to the orebody at depth relative to the existing workings. The mine maps effectively show the areas with unminable rock such as serpentine, "cinders," and dikes.

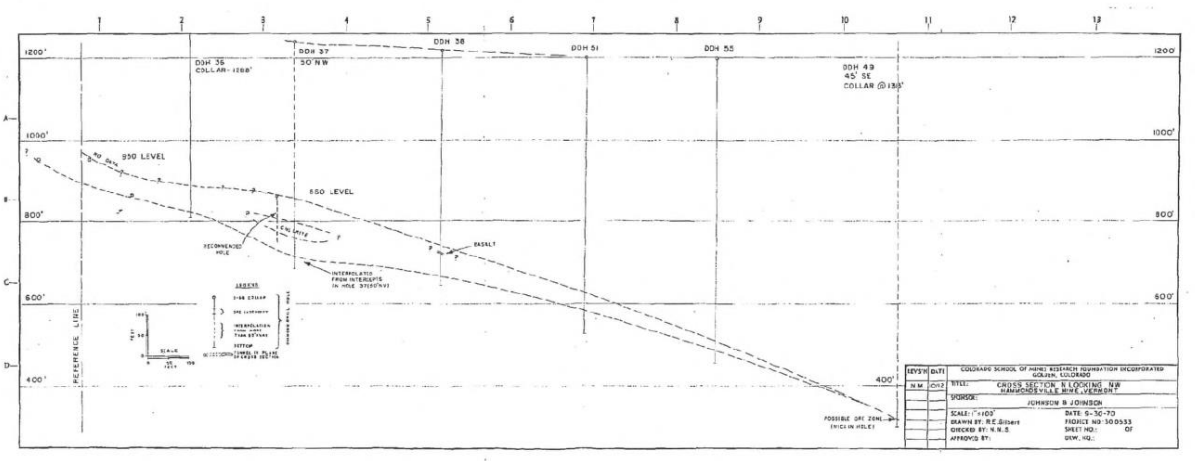

Figure 2*. An example cross section of the Hammondsville mine [Downey Ex. 16, p. 10 (JNJ 000261712)] showing drill hole locations relative to the ore body.*

During the 1980s, a Dosco continuous mining machine (CMM) was used at Hammondsville (and also used at Rainbow in the 1970s). The introduction of a CMM eliminated the need to drill and blast and allowed faster mining rates and even more selective mining. [Miller (1984).] Pure talc is very soft, and the cutting head on the CMM could not cut the harder schists in the hanging and footwalls and could not cut the harder low-grade talc. The CMM could stay in talc ore and away from non-talc dike material within 2.5 cm even as the dike material "*weaves and meanders through the mineable zone.*" [Miller (1984), p. 3.] The CMMs became "*automatic grade control devices.*" [Miller, p. 3.]

Studies by the consulting firm Pincock Allen and Holt were cited in IMERYS 436972. The hanging wall was found to be a relatively consistent orientation relative to the footwall; chlorite cinders were parallel to the talc foliation. Data in the report IMERYS 436972 indicate that the mine personnel had enough knowledge of the ore body and were using mining methods that were selective so that undesirable material from the edges of the talc bodies was avoided.

Cook is in further error when he cites data from the eight drilling campaigns at Argonaut as evidence that the ore deposits in Vermont were highly irregular and therefore could not be mined without contaminating the ore that went into Johnson's Baby Powder and Shower to Shower. [Cook Report, p. 7.]

In fact, each of these drilling campaigns was conducted to learn more about the ore body to minimize the risk of contaminating the ore and were adequate to do so. Selective mining at Argonaut was effective. For the period during which Argonaut was an underground mine, Downey notes high brightness ores were "*delineated by underground workings. Earlier miners always followed the best material and thus the* ***underground workings outline the best ore****.*" [Downey Ex. 37, p. 2 (IMERYS 499486).]

Additionally, drilling campaigns adequately delineated usable ore from waste. Drilling had been conducted in 1972, 1973, 1989, 1992, and 1998 at Argonaut. The first two campaigns were for a feasibility study on whether Argonaut could be mined underground. The 1978 campaign defined the northern limit of mining underground, three years before surface mining.

The 1989 campaign examined the feasibility of opening the north end of the deposit. The 1992 campaign looked at the feasibility of the south end of the deposit and defined the ore/waste boundaries in the north end and middle sections. The 1998 drilling was to better define ore/waste boundaries and examine the float feed properties of the ore. [Downey Ex. 23 (IMERYS 427424).]

IMERYS 427164 from 1997 documents that Argonaut was implementing a plan to track ore composition from blasthole assays to the mill and there were plans for close communication on quality control. The implementation of the traceability of the ore from mine to mill is evidenced in the 1999 mine plan. [IMERYS 499012.]

Approximately 2,500 feet of core was drilled in 1998. Hole locations for the nine holes drilled in 1998 are listed in Downey Ex. 23 [IMERYS 427424]. The holes were angled and the map on page 14 of Downey Ex. 24 shows the drill holes; they cover most of the orebody. The hole spacing appears adequate to meet the stated objective of examining ore/waste boundaries. [Downey Ex. 23 (IMERYS 427424).]

IMERYS 499012 summarizes the Argonaut mine plan in 1999 and illustrates the design process for selective mining. Very small blocks, 10 feet on a side, were used in the block model indicating that ore and waste were defined on very small dimensions. The proven ore reserve was defined only within 50 feet of the nearest sample, again indicating that the mining engineers and geologists were not projecting mineralization and rock properties too far from known mineralogy. Ore codes were distinct from waste rock codes in the computer model. For example, ore had one code but waste rock had four codes for serprentine, chlorite and cinders, schist and altered schist indicating it was important to know what type of waste rock was in proximity to ore. This level of specificity in the computer model indicates that the characteristics of each type of waste rock or gangue was carefully monitored for selective mining.

The block model was built with data from 391 drill holes and 2,442 assays which each had 32 different variables. Six assay variables, including arsenic, were used in each block. The block model used 1,900 composite sample data points for geostatistical analyses.

> "*An extensive cross-sectional analysis was done on the deposit to identify ore and waste contacts. Both vertical and horizontal cross-sections were used to separate the model blocks into 4 general categories: 1) current commercial ore (all grades: 5208, 5810, 5904, etc.); 2) Serpentine waste (including inter-pit waste); 3) Schist Waste (predominately footwall material); and 4) Chlorite waste (and associated cinders).*
>
> *The orientation of the Argonaut deposit required 41 regions (domains) that segregated the deposit into similar structure zones with regard to strike, dip and plunge. Each of the 5 quality characteristics from the composite file was interpolated into the block model where the rock type code was designated as ore.*
>
> *The final block model contains 10,758,400 cells of which 323,185 contain commercial ore. All cells within the block model were coded with ore and/or waste down to the 1150' elevation.*" [IMERYS. 499014.]

The costs and value assigned to each block in the model shows 156,072 blocks out of 10,758,400 were assigned to cosmetic-grade talc to be processed at the West Windsor mill.

Drill holes were not selected at random locations but are carefully sited to provide information to refine the mine plan. For example, IMERYS 499018 states: "*The new reserve delineation drilling must focus on proving out this East-side ore at depth. It is recommended that two core holes (shown on exhibit #4), each approximately 600' in depth should be drilled near cross-sections N16900 and N17100. Further review of the exact location of core drilling will be made before the final locations are chosen.*"

It is also noted that drilling and sampling were done on a regular basis during mining as part of the short-range planning. "***Assay drilling will continue throughout the year to update the model for short range planning***." [IMERYS 499018.]

Discrete sampling (grab samples for example) instead of compositing is also referenced to control arsenic levels: "***Frequent grab samples are also necessary***." [IMERYS 499020.]

The traceability of ore from the mine to the mill is described in terms of the segregation of stockpiles in storage. Each type of ore is stored in a different location. The block model allows the mine to know when each 10 foot cube of rock was mined, what type of ore it was, and where it was stored. The mine also used the block model to track the waste rock [IMERYS 499021].

Downey Ex. 36 indicates more drilling was conducted in 2002. Downey Ex. 37 explained the drilling in 2001 and 2002 was to drill across the hanging and footwall. Holes were spaced approximately 100 feet apart. The drilling better defined the east, west, and southern limits of the ore body and defined high-arsenic zones along fault structures.

A full revision of the mine plan for Argonaut was completed by 2003. At the time, all cosmetic talc used in Johnson's Baby Powder and Shower to Shower was beginning to be sourced from China. [Downey Ex. 26 (PowerPoint presentation).] 65 drill holes were completed at the time of the PowerPoint presentation and a roughly 100-foot grid was the goal with angled holes. Drill samples were composited on 10-foot intervals with 25-foot spacing for infill drilling. The bench height in the mine plan was 20 feet. Blocks in the block model were 10-foot cubes. Blasthole cuttings were assayed before mining (*see* Figure 3). The methods described in the document [Downey Ex. 26] follow the format of the international reporting standards dictated by the Joint Ore Reserve Committee (JORC.org).

[Figure 3 on next page]

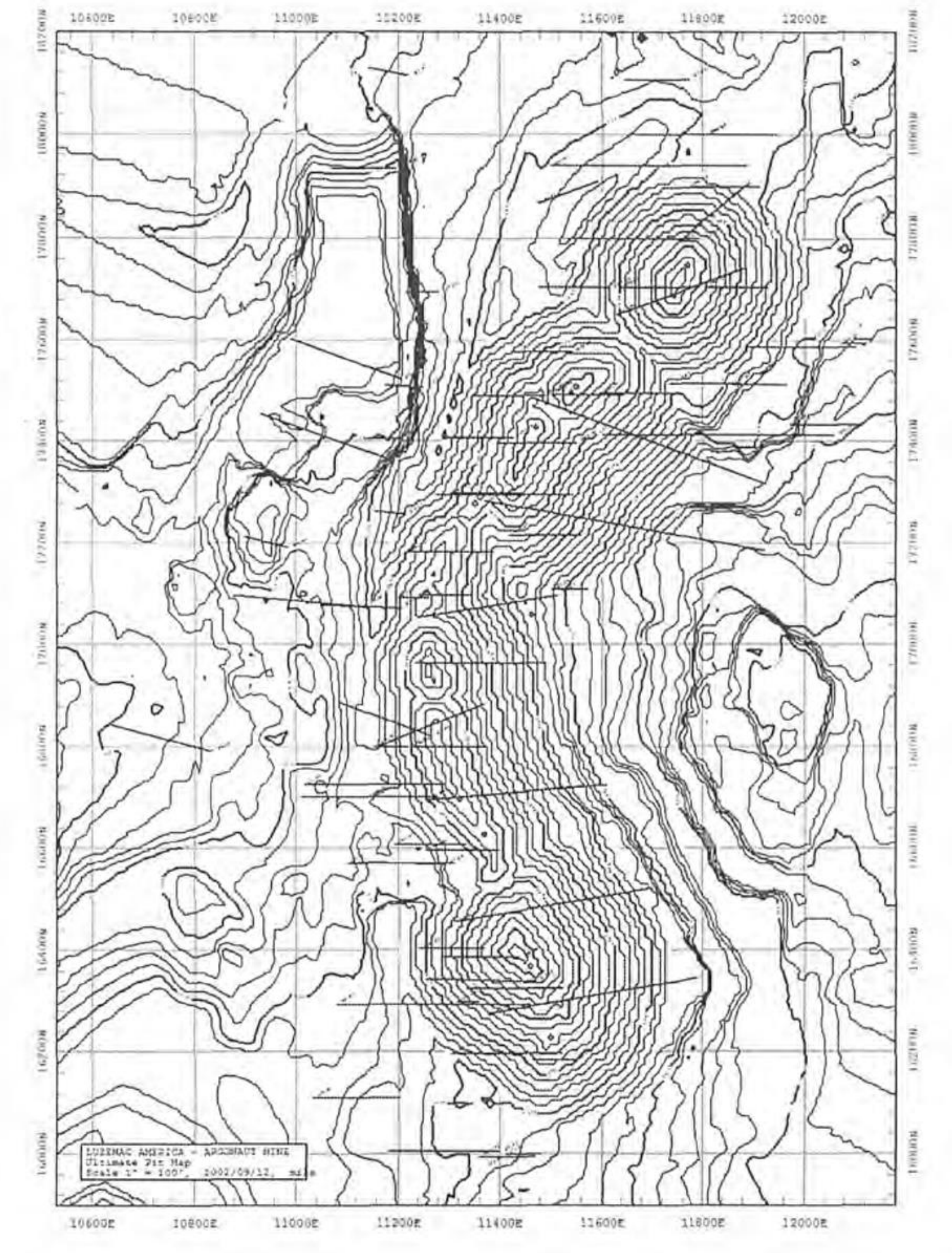

Figure 3. *The Argonaut East ore body with the pit limit and the location of angled drill holes (straight lines) across the ore body defining the limits of ore and waste and ore quality. [Downey Ex. 26 p. 28.] Note the drill holes intersect the width of the orebody and the samples are closely spaced in the north-south direction when projected to a horizontal plane.*

Enough stripping was completed by 1994 to start accessing the Argonaut East ore body. Photographs of the Argonaut East pit are shown in Figures 4-6. Note in the photographs, taken in 2005, that the boundaries between ore and waste are visible by color and texture. Selective mining took place with a 4.7 yd^3 excavator (approximate bucket width of 5 feet) and 35- to 40-ton capacity haul trucks and later with 65-ton haul trucks. [Downey Ex. 24, slide 21.]

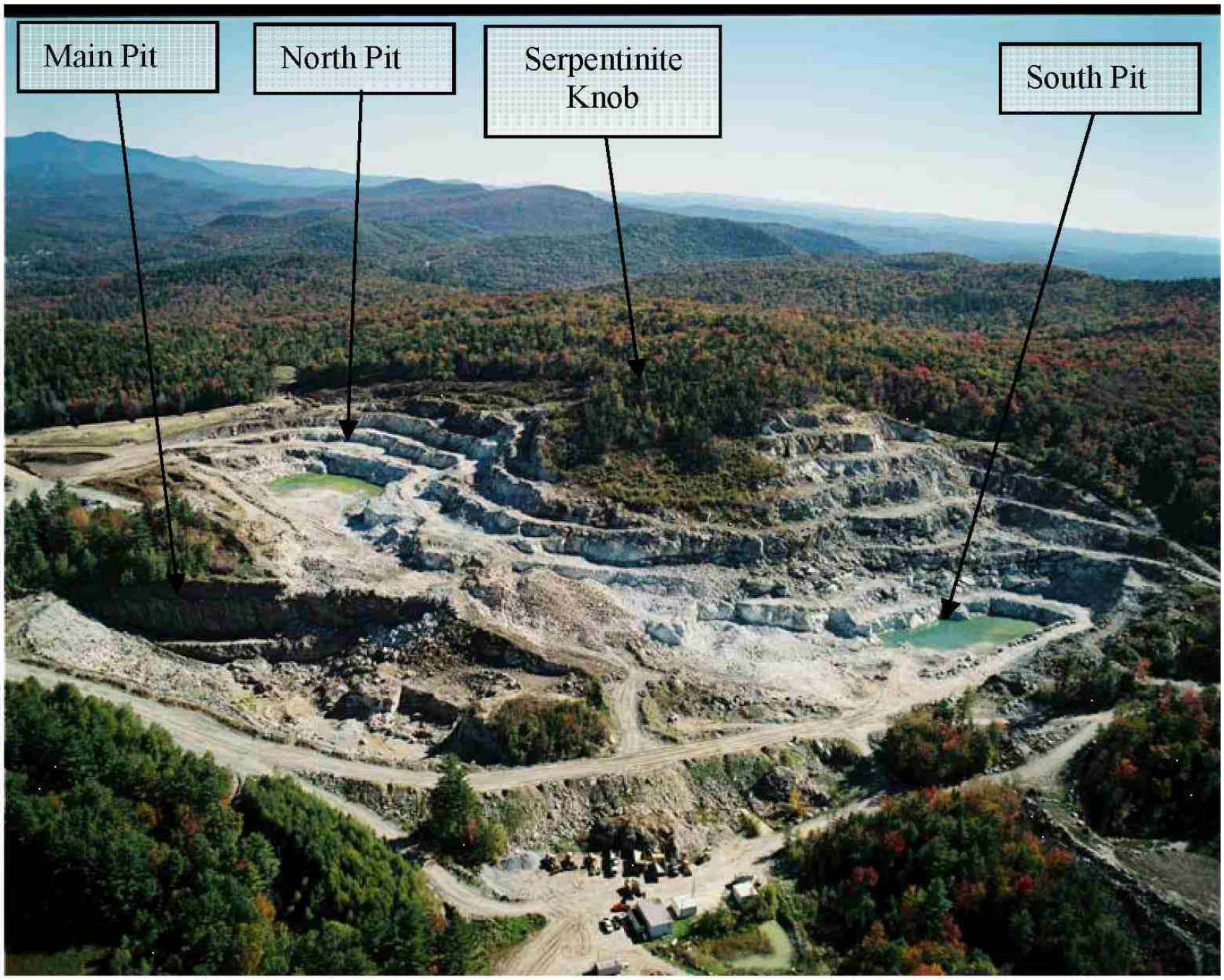

Figure 4a. *Argonaut East pit looking east. From Golder Associates report dated 2005. [IMERYS 501895.] Notice that the color changes between brighter white talc and darker serpentinite knob.*

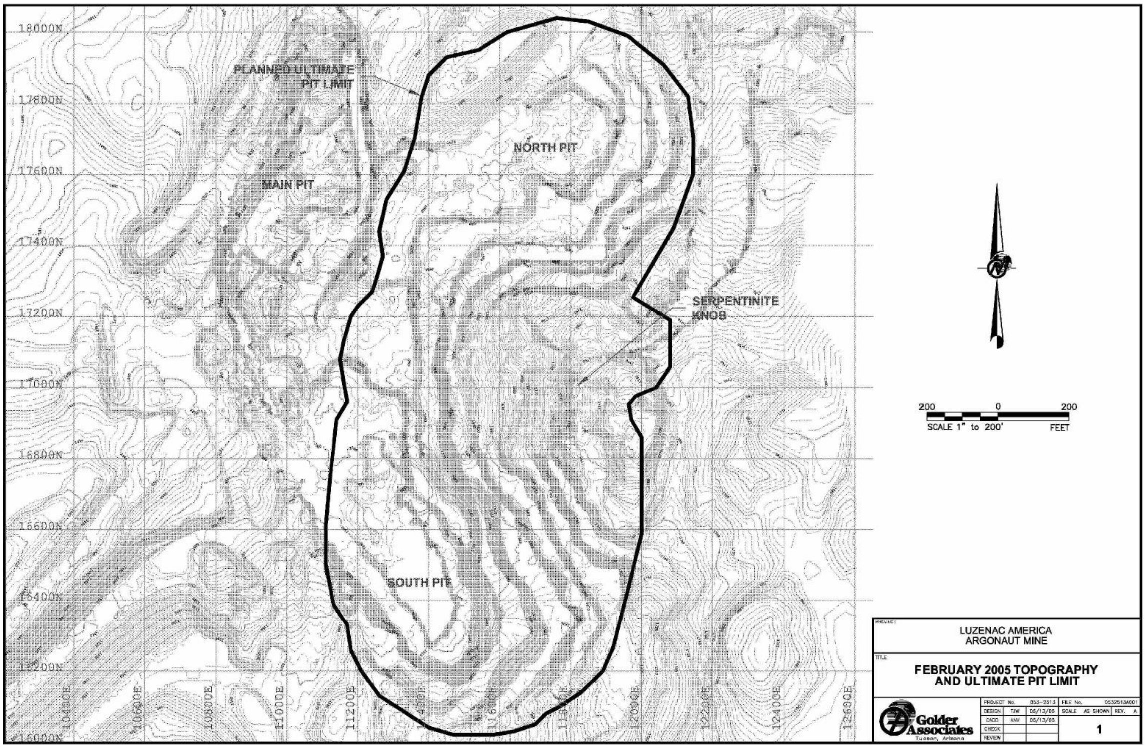

Figure 4b. *The ultimate pit limit from Golder Associates report dated 2005. [IMERYS 501901.] The map is oriented with north in the upward direction, so the map is roughly orthogonal to the photo in Figure 4a. The old Argonaut Main pit is in the lower-left field of view of the photograph in Figure 4a.*

Figure 5a. *East wall of South Pit at Argonaut mine. The lamprophyre dikes are noted at the base of the bench. Note the color differentiation between the rock types. [IMERYS 501896.]*

Figure 5b. *Close up of lamprophyre dikes. Notice the boundaries are sharp and it is easy to segregate this material during selective mining. [IMERYS 501897.]*

Figure 6. *A fault bounding the edge of the talc carbonate ore is identified. Notice the color change to distinguish the ore from waste is easily discernable. [IMERYS 501897.]*

Krekeler likewise makes flawed analysis of drill hole spacing when he states: "*However, in this case, the erratic spacing of cores only captures one dimensional or very limited views, of the mineralogically diverse and complex ore body from which information must be extrapolated to form a 3-D model. Examination of coring in documents shows Defendants failed to sample cores at sufficient density to characterize the complex ore bodies.*" [Krekeler Report, p. 41.]

In fact, as the map in Figure 3 above shows, the drill holes at the Argonaut mine were placed to gather specific information about the ore body as previously described above. The combination of core drilling and in-fill drilling provided sufficient density of information to populate computer models. [IMERYS 427291.]

Moreover, when mineralization is visually distinguishable, as was the case in Vermont, mapping is the primary grade control tool. Detailed geological mapping provides the only means of determining the best position for any sample and provides the basis for interpreting the sampling result. [Dominy and Minnitt (2011).]

"*The physical characteristics of the mineral deposit that are important to characterize are the size, shape, continuity of ore zones; the distribution and spatial variability of the mineral grade.* ***This information is never completely known but must be projected from sample data***." [Noble (2011), p. 203.] Since drill samples always represent a small fraction of the total volume of rock to be mined, special statistical methods weight samples and extend them from one sample point to another. This statistical method is called geostatistics (developed by French mathematician Georges Matheron in 1960 based on the master thesis of Danie Krige on gold distribution in the Witwatersand reef complex in South Africa). Normal statistics assumes samples are uncorrelated. Geostatistics assumes samples have a spatial correlation. Geostatistics allows us to assess the degree to which nearby sample values are spatially correlated and this allows us to construct a model of the grades throughout the deposit with minimum deviation or a best possible estimate compared to the sample data. [Noble, p. 213.]

Krekeler improperly assumes that only drilling at core density of 50 to 100 feet on a square grid pattern covering the entire ore body would allow effective selective mining in locations within the ore body where talc was extracted for cosmetic use at any given time: "*[I]n my opinion, should be drilling at a core density of 50 to 100 feet on a specific square grid pattern covering the entire ore body. Additionally, the location of drilling appears random, an atypical method for mining companies, who typically chose set distances to ensure that sample quality reflect available ore.*" [Krekeler Report, p. 39.] This is incorrect. Industrial minerals are often drilled on a 30 to 50 meter grid spacing. [Kogel et al. (2006), pp. 531, 557, 567, 585, 644, 673, 694, and 1009.] The Vermont mines were drilled on approximately 100-foot spacings and geostatistical analysis indicated this was an acceptable distance. [IMERYS 441340.]

There is no statistical formula that can be applied to precisely establish optimum drill-hole spacing for every kind of geology; ultimately it depends on the deposit geology and the experience of the mining company personnel and experience in the mining district to determine the appropriate sampling protocol. [Brown, R. (1990) p. 19.] Drill holes were spaced to provide maximum information on the ore body and the angled holes that were used could provide more information than vertical holes. [Downey Ex. 21 (IMERYS 238270); IMERYS 427291; IMERYS 441340.]

IMERYS MDL-AB-0009896 references the due diligence conducted by Rio Tinto prior to the acquisition of the talc assets from Cyprus Industrial Minerals, noting closely spaced drilling and sampling at the Rainbow mine: "*A recent study of arsenic concentrations, brightness values, and insoluble mineral concentrations completed on a* ***closely gridded drill pattern*** *confirms that there are areas in the pit bottom that have very low arsenic, values which are associated with high-brightness, high-grade talc ore*" [IMERYS MDL-AB-0009897].

Talc sourced from the Rainbow mine was first used for Johnson's Baby Powder in 1989 and was discontinued in 1995 when all mining operations were consolidated to Argonaut. [JNJ 000223445; IMERYS 156170.] Core holes were drilled at the Rainbow mine in 1976, 1978, 1979, 1981, 1982, and 1987. [IMERYS 498911.] The arsenic-bearing minerals Annabergite and Pitticite were noted in the Rainbow mine and a management plan was implemented. The implementation plan included selective mining to avoid arsenic-bearing rock; mapping the host rock (an intrusive dike at Rainbow); visual observation (Pitticite is bright yellow and Annabergite is bright green); sample pit walls, blast holes, and stockpile; and monitor the product. [JNJ 000870880.]

Krekeler is also incorrect in his representation of drilling at the Hamm mine in 1992; he states that "*multiple impurities in the talc ore should have called into question, for a responsible mining company, the overall quality of the ore. These impurities included abundant bladed actinolite zones associated with chlorite/hornblende/biotite schist and talc schist (IMERYS 435988), fibrous tremolite (IMERYS 435992), and amphibole at 2-3% and fibrous actinolite (IMERYS 436000). These findings indicate that the talc is intimately associated with asbestiform minerals and the association was easy to recognize in these deposits.*" [Krekeler Report, pp. 31-32.]

The documents cited by Krekeler in support [IMERYS 435988, 435992, and 43600] are handwritten drill logs for the 1992 drill holes at the Hamm mine. The purpose of the drilling was to delineate zones of ore and zones with amphiboles and other contaminants that would not be mined. Krekeler is incorrect that identifiation of amphibole or actinolite means these minerals were included in ore processed for Johnson's Baby Powder or Shower to Shower.

Four additional drill holes were placed at the Hamm mine in 1992 in order to further delineate boundaries between usable ore and waste. [IMERYS 238270.] A total of 1,027 feet of NQ sized core was drilled. NQ has a hole diameter of 75.7 mm and is one of the most common core sizes. [de la Vergne (2012), p. 4.] The drill holes were surveyed for location and inclination. The core was logged on site using Cyprus' classifications of ore type. Drill hole 92-1 was to test the extent of type 30 ore (talc/carbonate, 40-55% talc) exposed in the pit bottom and delineate the serpentinite mass. Drill hole 92-2 was to add confidence to the area of projected reserves on section 4+00 and delineate amphibole exposed in the southern pit wall. Drill hole 92-3 was to provide data in the previously untested middle of the pit on section 5+00. Drill hole 92-4 was placed near drill hole 92-3 to fix the hanging wall location in the center of the deposit and test the internal waste rock in the pit. Drill hole 92-4 recovered serpentinite and chloritized mafic dike and garnet schist in the footwall.

Fibrous actinolite was identified in the chloritic dikes, waste rock believed to extend a few inches into the talc at the contact with the talc. The fibrous habit of the actinolite was not

identified to meet the definition of asbestiform. Regardless, this extension would have been covered by the margin maintained between usable ore and waste. In his deposition, Patrick Downey testified that the margin left between usable ore and waste was a certain number of bucket widths, measured by the width of the bucket on the excavator, which would have been several feet. [Downey Dep. 246:13-23, Aug. 7, 2018.] No other asbestiform minerals were found in the four drill cores. Arsenic was neglible in the four cores with the highest assay at 0.88 ppm at the bottom of hole 92-2.

Samples containing fibrous amphibole were not analyzed because amphibole material was automatically deemed waste and was not going to be mined. [IMERYS IMERYS 238271.] The drilling indentified thick serpentinite and chloritized mafic dikes with fibrous actinolite which were not observed at the current mining elevations but would reduce the reserves because the material would not be mined.

Krekeler further incorrectly opines that relevant mining operations did not use mine maps or 3-D models; he writes: "*Typically, when mining companies deal with complex ore bodies that could contain asbestos or asbestiform habit minerals, they would take reasonable precautions to exclude this material in the product production stream. These precautions would include developing mine maps from drill cores and core logs, and employing progressive mapping techniques like 3-D maps, which are developed to guide the mining process.*" [Krekeler Report, p. 39.]

This opinion ignores the fact that mine maps were developed from drill cores and core logs. 3-D maps require computer modelling, and, in fact, computer models were used dating back to the ownership by Cyprus Industrial Minerals in the late 1980s and the early 1990s when they became more widely available and affordable, 3-D maps were made. [Downey Ex. 21 (IMERYS 238270); IMERYS 441340.] Numerous references are made to selective mining and characterization of potential contaminants. Cores were logged and entered into models. Ore reserves were calculated, and "no-go" zones identified as waste. [Downey Ex. 21 (IMERYS 238270).] IMERYS 156170 references computer modeling of the Argonaut mine dating to the time of the Rio Tinto acquisition in 1992. The mine plan was updated in 1992 and again in 1999 with an addition of 2,000 feet of core samples and more surface mapping of the geology. Updates to the plan were referenced in 2003 [Downey Ex. 26] and 2008 [IMERYS 441340].

An indication of selective mining and careful quality control is given by the statement, "*The ore is mined selectively for consistency and segregated throughout the process. Routine sampling of the ore and the finished product for asbestos analysis by a Transmission Electron Microscope (TEM) consistently produces values of non-detectable fibers. Additionally, core samples analyzed by TEM have not indicated the presence of any fibrous material.*" [IMERYS 156176.] "*The site is drilled in preparation for the controlled blasting of ore. Samples from the drilling are taken to the nearby Ludlow Mill lab for analysis to validate the mine model. The ore is then released for crushing and is transported to the West Windsor Mill by truck or to the Ludlow Mill via conveyors*." [IMERYS 156176-77.]

Krekeler relies on incomplete information to state that he has found "*evidence of quality control gaps in data, including variations in the physical characteristics of the mined rocks, otherwise known as the rock's lithology. IMERYS 427429 provides no depth for Core R-98-2,*

and in IMERYS 426685 there are conflicting lithology given for Core R-98-9. The documents offer no justification for these discrepancies, suggesting an insufficient sampling process, poor review process, or both. These quality control gaps are concerning because an area of high contamination could be missed if a region of the geology is poorly defined. Despite inadequate sampling and testing of ore deposits, detectable asbestos was found." [Krekeler Report, pp. 39-40.]

Krekeler relies on IMERYS 427429 as evidence that there is no depth indicated for hole R-98-2. This document is a typed list of core logs from the 1998 drilling campaign. These logs are not on logging forms and do not have rock types coded as the other logs do that were used at Argonaut. Notably, IMERYS 499036 is an Excel spreadsheet with drill hole data from 1972 to 2009, and in the spreadsheet there is no missing information for hole R-98-2. The hole length was 500 feet. The lithology is completely documented for the length of hole R-98-2; the top 20 feet of the hole was overburden material. Serpentine was encountered from 20 to 285 feet. Talc was logged from 285 to 355 feet. Schist was mapped from 355 to 361 feet; one foot of chlorite was noted from 361 to 362 feet. Talc was mapped from 362 to 500 feet.

Krekeler relies on IMERYS 426685 for the proposition that R-98-9 has conflicting lithologies. However, in Downey Ex. 33 the lithologies listed in the logs for core R-98-9 are consistent. In addition, Krekeler states that detectable asbestos was found in core R-98-9. Downey Ex. 34 is the analysis for a sample labeled 1261 from drill hole R-98-9 done in 2003. A trace amount of tremolite was detected by XRD. The tremolite was confirmed by PLM but was not identified as asbestiform. Krekeler's citation of IMERYS 426685 appears to be the ninth page of Downey Ex. 35, which has a memo dated April 27, 1998. The document contains a map for Argonaut showing the drill hole locations with the horizontal distance covered by the angled holes. The log for hole R-98-9 in Downey Ex. 35 is the same as in Downey Ex. 33 with the addition of handwritten notes in Downey Ex. 33 that consolidate some of the rock types in certain depth intervals. **There is no fundamental inconsistency in the log for this hole that indicates a lack of diligence**. Furthermore, the logs in IMERYS 499036 for hole R-98-9 match the data in Downey Ex. 33 and Downey Ex. 35.

Cook relies on a flawed understanding of mining practices to state: "*In short, it is almost impossible to operate a mine in commodities that occur in relatively small irregular deposits such as high-quality talc without periodically incorporating host rock, low grade ore, and/or otherwise undesirable ore, into the material being removed from the mine and processed.*" [Cook Report, p. 6.]

In reality, the boundaries around the talc as represented in the Argonaut photos in Figures 4-6 indicate sufficiently distinct boundaries between rock types such that segregation of ore and waste was certainly possible. Drill logs from the Hamm mine use color as one identifier of ore and gangue [Downey Ex. 17, for example]; descriptions of the black blackwall schist [Downey Ex. 14, p. 10 (JNJ 000245017)] and green "verde antique" rock [Downey Ex. 14, p. 11 (JNJ 000245018)] are additional indications of the importance of visual cues to accurately distinguish ore from gangue. Using visual differences between rock types to segregate ore and waste is not unusual in mining. Coates describes ore grade control at a gold mine in Australia as follows: "*Additional sampling is required in some areas where transitional boundaries, are present between medium and low grade ore. Additional sampling is not undertaken to define low grade*

to waste boundaries as the value of the extra low grade ore defined, or dilution by waste avoided, does not justify the expenditure. ***Where in doubt, these boundaries are decided in the pit by a geologist on lithological appearance***." [Coates (1993), p. 131.] Coates also notes that "*[i]n structurally controlled orebodies the* ***most important guide to good grade control is in pit geological mapping*** *. . . and in pit mapping at Sons of Gwalia mine aids ore lens delineation.*" [Coates (1993) p. 132.]

Further, Coates notes the excellent grade control achieved by equipment operators in the mine: "*In particular, excavator operators have an influence on the degree of ore loss or dilution and are able, by mining up foliation from east to west,* ***to mine ore to within 20 cm of the midline of ore boundaries***." [Coates (1993), p. 132.]

At his deposition, Cook testified that the photograph of the excavator on page 8 of his supplemental report was indication that selective mining was not possible, given the size of the machine. [Cook Dep. 486:8-488:15, Jan. 30, 2019.] He also testified that he could tell from photographs of the Hamm and Argonaut mines in Appendix B of his supplemental report that selective mining was not performed, because of visible waste rock. [Cook Dep. 503:8-505:5.] Cook concludes from these same photographs that selective mining was not obvious as to the Argonaut, Rainbow and Hamm mines. [Cook Report, pp. 7-8.] However, these photographs do not depict the Rainbow mine.

Furthermore, there are few pictures from Argonaut and even fewer from the Hamm mine, and they were re-used in presentations and reports without details on where and when they were taken. For example, IMERYS 499550 is the same as Downey Ex. 24, slide 8. IMERYS 501911 is the same image as IMERYS 499555; there are at least 7 pictures from Argonaut that are re-used between documents IMERYS 436951, IMERYS 499538, IMERYS 501902, Downey Ex. 24 and Downey Ex. 26.

The picture referenced by Cook in his expert report on page 8 is from Downey Ex. 24 on page 23 in a presentation that appears to be from sometime in 2002 based on data presented. The picture is in a section of the presentation on generic mine operations without reference to when or where the pictures were taken or what stage of mining was taking place. The picture shows an excavator (also called a hydraulic backhoe) and haul truck surrounded by rock. The picture is different than all others showing mining at Argonaut (for example, Figure 7 below from IMERYS 501911 or the pictures of the mine as shown in IMERYS 500820 at slide 27). The only pictures of excavators in the documents appear to be Caterpillar model 245C, which has a bucket width of approximately 3-5 feet depending on the exact bucket installed. The equipment inventory for the Ludlow Mines in Vermont in 1987 listed a Caterpillar 235 hydraulic excavator which typically has a bucket capacity of 1.9 m^3 (about 2.5 yd^3), which is approximately 4 feet in width (235C and D models). [Downey Ex. 9, p. D-5.] IMERYS 501908-10 states that Argonaut was using a Caterpillar 365 excavator at least by 2006 when the document appears to have been written. The 365 model C has a bucket capacity of 3.6m^3 (~ 4.7 yd^3) which is approximately 5 feet in width. Berkhimer notes that hydraulic excavators "*[c]an selectively mine layers or pockets of material*." [Berkhimer (2011), p. 936.] All of the equipment listed in documents and shown in photographs is small enough to be used for selective mining.

IMERYS 501910, from approximately 2006, states that the mining equipment at Argonaut consisted of "*two 65-ton Caterpillar 773 haul trucks, one 55-ton Terex haul truck, one Caterpillar 365 excavator, and two Caterpillar 890 front-end loaders.*" Downey Ex. 24 (slide 21) references 35- and 40-ton haul trucks. A 40-ton rigid frame haul truck would be comparable to the CAT model 769 truck used for quarries and appears similar to trucks shown in the pictures. [Downey Ex. 24, slide 23; IMERYS 501911.] The model 769 and 773 trucks are the smallest mining and quarry rigid frame trucks that Caterpillar builds. The haul truck shown in Downey Ex. 24 on slide 24 appears to be an approximately 20 ton articulated haul truck. A Terex haul truck is shown in IMERYS 500820, slide 27.

The picture referenced by Cook on page 8 of his supplemental report is not typical for an area producing ore as there is no clear bench, and it is difficult for the truck and shovel to maneuver which is inefficient when mining ore. IMERYS 499012 (4-30-1999 Argonaut report.pdf) notes the bench width for safe movement of the excavator and haul truck should be 60 feet. [IMERYS 499015.] The picture referenced by Cook on page 8 of his amended report does not show adequate room to maneuver and supports the conclusion that the picture is not related to mining ore.

Cook is incorrect in his interpretation of this picture as definitively showing non-selective mining. The picture is more likely representative of the opening of the Argonaut East orebody as shown in IMERYS 436952 from around 1991, which would indicate the excavator was handling waste or industrial talc.

Figure 7*. Picture from IMERYS501911 showing excavation of talc ore. The excavator model shown is a Caterpillar 245C which is an older excavator than the Caterpillar 365 excavator referenced in IMERYS 501910. The CAT 245C excavator can use different bucket sizes ranging from 36 inches to 67.*

As noted above, continuous mining machines (CMM) were employed at several of the Vermont mines, facilitating even more selective mining. [IMERYS 117598.] Pure talc is very soft, and the cutting head on the CMM could not cut the harder schists in the hanging and footwalls and could not cut the harder low-grade talc. The CMM could stay in talc ore and away from non-talc dike material within 2.5 cm even as the dike material "*weaves and meanders through the mineable zone.*" [Miller (1984), p. 3.] The CMMs became "*automatic grade control devices.*" [Miller (1984), p. 3.]

Mining equipment described at the Argonaut mine was sized appropriately for the mining zones, mine layout (e.g., bench height and width) and required production. The margin maintained between usable ore and waste, measured in bucket or shovel widths, was sufficient to mine target ore and exclude waste. [Dep. Downey 246:13-23, Aug. 7, 2018.]

Furthermore, Downey Ex. 24 lists production from Argonaut at 190,000 tons per year. If the operation ran 5 days per week (260 days per year) then the mine moved approximately 730 tons per day which is about 11 truck-loads per day for the 65-ton trucks and about 21 truck-loads for the 35-ton trucks. This low rate of loading and hauling allows for enough time to be careful in sorting material at the dig face. *"Blasting is typically scheduled on a weekly basis with ore segregation occurring directly at the muck pile"* [IMERYS 501910], which indicates the equipment operator and geologist had ample time to mine selectively.

J. Other Methodological Issues.

Krekeler incorrectly conjectures that the green color of rocks collected by David Crouse on a field visit in 2007 "*is significant in that the green color indicates it likely has appreciable levels nickel and other toxic metals.*" [Krekeler Report, p. 11.] The samples collected by Crouse, however, were only vaguely described in IMERYS 415991, and were not represented by color photographs in the report examined. There is no published analysis of these samples.

Krekeler also states the following: "*As far back as 1983, Defendants had information indicating that Chinese talc contains higher than normal heavy metal contents, like lead, cobalt, chromium iron, nickel and titanium. See JNJ 000059273 ('The trace metal analyses indicate the lead content may rise to undesirable levels on an average mine basis at Guping Pit. It is expected that higher than normal heavy metal contents will be concentrated in the gray and green talc components.').*" [Krekeler Report, p. 11.]

The report [JNJ 000059273 (JNJNL61_000002060)] actually states that the talc was high quality, met CTFA standards and did not have high lead or other metal content. The report further states that "*[t]he average grade of ore taken across the open face of Guping Pit will be a mixture of white, green, and gray talcs. Such a mixture can be expected to produce a talc powder below cosmetic talc standards . . . The indications are that the ore has to be selectively mined for the white rock. Green and gray talc components should be rejected up to the limits of practicability. The contact zones high in dolomite should be avoided in mining cosmetic grade ore . . . No varieties of asbestos minerals have been found.*" [JNJ 000059273, p. 28 (JNJNL61_000002087).] The report is identifying that on average, there were enough impurities to lower the quality of the talc from this pit but if selective mining was used, the high-grade zone met the standards required for talc used in Johnson's Baby Powder or Shower to Shower.

V. <u>CONCLUSIONS</u>

In their expert reports, Drs. Cook and Krekeler use flawed methodologies, incomplete sampling results, and incorrect facts about ore body characterization and selective mining to reach their conclusions that the cosmetic-grade talc sourced for use in Johnson's Baby Powder and Shower to Shower was known to contain asbestos and heavy metals that exceeded product specification. Based on analysis of the reports of Drs. Cook and Krekeler, examination of documents presented, use of reference literature, and my engineering experience, I have provided support for the opinions set forth in Section I of my report.

I reserve the right to supplement my opinion should additional information be received.

Bibliography

Afewu, K, and Lewis, G, 1998, "Sampling of run-of-mine mill-feed: A practical approach", Journal of the South African Institute of Mining and Metallurgy, Oct 1998, pp. 299-304

Berkhimer, E., 2011, "Selection and sizing of excavation, loading, and hauling equipment", Chap 10.4, p. 936, Mining Engineering Handbook, 3rd Ed., Society of Mining, Metallurgy and Exploration, Denver

Brown, R., 1990, "Exploration and Geology Techniques, Overview of Exploration, in Kennedy, B., ed, Surface Mining, Second Edition, Chapter 2.1, p. 19, Society of Mining, Metallurgy and Exploration, Denver, CO

Coates, S., 1993, "Geology and Grade Control at the Sons of Gwalia Mine, Leonora, Western Australia", International Mining Geology Conference, Kalgoorlie WA, 5- 8 July 1993, pp. 125-132

Coggiola, M., MD, Bosio,D., MD, Pira, E., MD, Piolatto, P., MD, La Vecchia, C., MD, Negri, E., PhD, Michelazzi, M., MD, and Bacaloni, A., PhD., 2003, "An Update of a Mortality Study of Talc Miners and Millers in Italy", American Journal of Industrial Medicine, 44(63-69)

de la Vergne, J., 2012, Hard Rock Miner's Handbook, 4th Edition, Stantec Consulting, Phoenix, AZ, p. 4

Dominy, S., and Minnitt, R., 2011, "Design of Grade Control Sampling Programs for Underground Gold Mines", Eighth Annual Mining Geology Conference, Queenstown, New Zealand, August 22-24, 2011, pp. 217-284

Evans, A., 1996, Ore Geology and Industrial Minerals: An introduction, 3rd Edition, Blackwell, Oxford, U.K., p. 69

Guilbert, J., and Park, C., 1986, The Geology of Ore Deposits, Freeman, New York, pp. 66-67 and p. 844

Hamrin, H., 2001, Underground mining methods and applications, pp3-5, pp9-10, in Hustrulid, W., and Bullock, R., (Eds) Underground Mining Methods: Engineering Fundamentals and International Case Studies. Society of Mining, Metallrugy, and Extraction, Denver, CO

Kogel, J., Trivedi, N., Barker, J., and Krukowski, S., 2006, Industrial Minerals and Rocks, 7th Ed., Society of Mining, Metallurgy and Exploration, Denver, p. 531, p. 557, p. 567, p. 585, p. 644, p. 673, p. 694, p. 1009

Miller, R., 1984, "Talc Mining in Vermont – the application of continuous mining machines", Pre-print 84-358 SME annual meeting, Denver, CO

Noakes, F., 2005, "The customer's king at Three Springs", Australian Mining, April 2005, pp. 32-34

Noble, A., 2011, "Resource Estimation", Chap. 4.5, p203, p206, p213, Mining Engineering Handbook, 3rd Ed., Society of Mining, Metallurgy and Exploration, Denver

Pira, E., Coggiola, M., Ciocan, C., Romano, C., La Vecchia, C., Pelucchi, C., Boffetta, P., 2017, "Mortality of Talc Miners and Millers from Val Chisone, Northern Italy, An Updated Cohort Study", JOEM, 2017, vol 59, no 7, pp. 659-664

Post, E., Rademacher, M., and Hill Jr., W., 2011, Sample preparation and assaying, Chap 4.3, p 187, in Mining Engineering Handbook, 3rd Ed., Society of Mining, Metallurgy and Exploration, Denver

Spedden, R., Introduction, p. 30-9, 1985, in Sampling and Testing, ed(s) Spedden, H. Rush ; Ananthapadmanabhan, K. P. ; Bergstorm, B. H. ; Brison, R. J. ; Cooper, H. R. ; Harper, R. W. ; Hellyer, W. C. ; Hellyner, W. C. ; Herbst, J. A. ; Hopstock, D. M., Society of Mining, Metallurgy and Exploration, Denver, CO.

Stanley, C., 2007, "The Fundamental Relationship Between Sample Mass and Sampling Variance in Real Geological Samples and Corresponding Statistical Models", Exploration and Mining Geology, Vol 16, nos 1-2, pp. 109-123

Materials Reviewed and Considered

Scientific Literature

Afewu, K, and Lewis, G, 1998, "Sampling of run-of-mine mill-feed: A practical approach", Journal of the South African Institute of Mining and Metallurgy, Oct 1998, pp 299-304

Berkhimer, E., 2011, "Selection and sizing of excavation, loading, and hauling equipment", Chap 10.4, pp 931-939, Mining Engineering Handbook, 3rd Ed., Society of Mining, Metallurgy and Exploration, Denver, CO

Bideaux, R., 1990, Ore Reserve Estimation, in Kennedy, B., ed, Surface Mining, Second Edition, Chapter 3.1, pp 287-292, Society of Mining, Metallurgy and Exploration, Denver, CO

Boundy, M.G., et al., 1979, "Occupational Exposures to Non-Asbestiform Talc in Vermont", pp 365-378, in Lemen, R. and Dement, John M., eds, Dusts and Disease, Park Forest South, IL

Brown, R., 1990, "Exploration and Geology Techniques, Overview of Exploration, in Kennedy, B., ed, Surface Mining, Second Edition, Chapter 2.1, pp 15-21, Society of Mining, Metallurgy and Exploration, Denver, CO

Coates, S., 1993, "Geology and Grade Control at the Sons of Gwalia Mine, Leonora, Western Australia", International Mining Geology Conference, Kalgoorlie WA, 5- 8 July 1993, pp 125-132.

Coggiola, M., Bosio,D., Pira, E., Piolatto, P., La Vecchia, C., Negri, E., Michelazzi, M., and Bacaloni, A., 2003, "An Update of a Mortality Study of Talc Miners and Millers in Italy", American Journal of Industrial Medicine, 44(63-69)

De la Vergne, J., 2012, Hard Rock Miner's Handbook, 4th Edition, Stantec Consulting, Phoenix, AZ, 314 pp.

Dominy, S., and Minnitt, R., 2011, "Design of Grade Control Sampling Programs for Underground Gold Mines", Eighth Annual Mining Geology Conference, Queenstown, New Zealand, August 22-24, 2011, pp 217-284

Evans, A., 1996, Ore Geology and Industrial Minerals: An introduction, 3rd Edition, Blackwell, Oxford, U.K., 389 pp.

Gamble, J.F., and Gibbs, G.W., 2007, "An evaluation of the risks of lung cancer and mesothelioma from exposure to amphibole cleavage fragments", Regulatory Toxicology and Pharmacology, 52(S154-86)

Guilbert, J., and Park, C., 1986, The Geology of Ore Deposits, Freeman, New York, 985 pp.

Hamrin, H., 2001, Underground mining methods and applications, p 3-14, in Hustrulid, W., and Bullock, R., (Eds) Underground Mining Methods: Engineering Fundamentals and International Case Studies. Society of Mining, Metallrugy, and Extraction, Denver, CO, 718 pp.

Kogel, J., Trivedi, N., Barker, J., and Krukowski, S., 2006, Industrial Minerals and Rocks, 7th Ed., Society of Mining, Metallurgy and Exploration, Denver, CO, 1548 pp.

Miller, R., 1984, "Talc Mining in Vermont – the application of continuous mining machines", Pre-print 84-358 SME annual meeting, Denver, CO

Noakes, F., 2005, "The customer's king at Three Springs", Australian Mining, April 2005, pp. 32-34

Noble, A., 2011, "Resource Estimation" , Chap. 4.5, pp 203-217, Mining Engineering Handbook, 3rd Ed., Society of Mining, Metallurgy and Exploration, Denver, CO

Pira, E., Coggiola, M., Ciocan, C., Romano, C., La Vecchia, C., Pelucchi, C., Boffetta, P., 2017, "Mortality of Talc Miners and Millers from Val Chisone, Northern Italy, An Updated Cohort Study", JOEM, 2017, vol 59, no 7, pp 659-664

Post, E., Rademacher, M., and Hill Jr., W., 2011, Sample preparation and assaying, Chap 4.3, pp. 187-192, in Mining Engineering Handbook, 3rd Ed., Society of Mining, Metallurgy and Exploration, Denver, CO

Stanley, C., 2007, "The Fundamental Relationship Between Sample Mass and Sampling Variance in Real Geological Samples and Corresponding Statistical Models", Exploration and Mining Geology, Vol 16, nos 1-2, pp 109-123

Expert Reports

2018.11.16 - Expert Report of Robert B. Cook, PhD
2018.11.16 - Expert Report of Mark Krekeler, PhD
2019.01.17 - Addendum to the Expert Report of Mark Krekeler, PhD
2019.01.22 - Amended Expert Report of Robert B. Cook, PhD

Deposition Transcripts and Exhibits

2018.02.11 - Pier, Julie Deposition
2018.04.13 - Blount, Alice Deposition
2019.01.25 - Krekeler, Mark Deposition
2019.01.30 - Cook, Robert Deposition
2018.06.29 - Hicks, Donald Deposition
2018.08.07 - Downey, Patrick Deposition and Exhibits
2018.08.08 - Downey, Patrick Deposition and Exhibits
2018.08.16 - Hopkins, John Deposition
Hopkins Depo. Ex. 24 (2018.08.17)
Hopkins Depo. Ex. IMERYS-5
Hopkins Depo. Ex. J&J-1
Hopkins Depo. Ex. J&J-2
Hopkins Depo. Ex. J&J-9
Hopkins Depo. Ex. J&J-15
Hopkins Depo. Ex. J&J-19
Hopkins Depo. Ex. J&J-23
Hopkins Depo. Ex. J&J-28
Hopkins Depo. Ex. J&J-29
Hopkins Depo. Ex. J&J-30
Hopkins Depo. Ex. J&J-31
Hopkins Depo. Ex. J&J-33
Hopkins Depo. Ex. J&J-34
Hopkins Depo. Ex. J&J-36
Hopkins Depo. Ex. J&J-44

Hopkins Depo. Ex. J&J-46
Hopkins Depo. Ex. J&J-47
Hopkins Depo. Ex. J&J-57
Hopkins Depo. Ex. J&J-58
Hopkins Depo. Ex. J&J-65
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Websites

JORC.org
OneMine.org

Johnson & Johnson Defendants' Productions

J&J-0007797 - JNJMX68_000012854
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Other

FDA Memorandum dated January 7, 1976, from Ronald L. Yates, Product Composition Branch, to Heinz J. Eirmann, Director, Division of Cosmetics Technology

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WCD002478
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EXHIBIT A

MARY M. POULTON

Professor Emerita
Mining and Geological Engineering
Co- Director, Lowell Institute for Mineral Resources
The University of Arizona
Home Address:
15521 N. Howe Road
Mead, WA 99021
E-MAIL: mpoulton@email.arizona.edu
Alt. E-mail: uaminingcat@gmail.com
Ph: 509 863 9633
Cell: 520 603 0210

TESTIMONY HISTORY

I have not provided testimony in any prior court cases.

EDUCATION

Ph.D. in Geological Engineering, University of Arizona, 1990. Dissertation title: “Neural network pattern recognition of electromagnetic ellipticity images”; Dr. Charles E. Glass, Director.

M.S. in Geological Engineering, University of Arizona, 1987. Thesis title: “Extraction of surface and subsurface geologic information from the proposed Arizona superconducting super collider sites”; Dr. Charles E. Glass, Director.

B.S. with Distinction in Geological Engineering, University of Arizona, 1984. Emphasis in mining and exploration.

Pre-engineering program, Western Illinois University, 1980-1982.

EMPLOYMENT

August 2018 – present: Contractor to NIOSH Spokane Mining Research Division through contract with GES/AECOM

June 2018 – present: Co-director, Lowell Institute for Mineral Resources, University of Arizona, Tucson, AZ

August 2017 – June 2018: Part time temporary employee, University of Arizona, Tucson, AZ (teaching and research contracts)

August 2017-February 2018: Expert consultant to NIOSH, Spokane Mining Research Division, Spokane, WA

July 2017 onward: Chief Operating Officer and CEO as of April 2018, Desert Saber LLC, Tucson, AZ

June 2017 onward: Co-founder, Guia LLC, Tucson AZ

May 2017 onward: Professor Emerita, Mining and Geological Engineering, The University of Arizona

2015 to May 2017: University Distinguished Professor in Geosciences, Mining Engineering, Law, and Public Health

2010 to May 2017: University Distinguished Professor in Mining and Geological Engineering

2009 to May 2017: Director, Lowell Institute for Mineral Resources

2004 Guest Professor, Chengdu University, China, Spring 2004.

2003 to 2015: Professor, Mining and Geological Engineering, University of Arizona; courtesy appointments in Geosciences Department and Division of Community Environment Policy in Mel and Enid Zuckerman College of Public Health.

July 1, 2000 to January 1, 2015: Head, Department of Mining and Geological Engineering, University of Arizona.

1996 to 2003: Associate Professor, Mining and Geological Engineering, University of Arizona.

1990 to 1996: Assistant Professor, Mining and Geological Engineering, University of Arizona

1989: Adjunct Instructor, Geological Engineering, University of Arizona. Responsible for teaching a 400-level course on the fundamentals of geotechnics, a 400-level course on computer methods and a 100-level course on mineral resources, geotechnology and the environment.

1988, Spring: Graduate Assistant, University of Arizona. Worked on seismic data processing and interpretation for the superconducting super collider site investigation.

Fall: Research Assistant working on neural network applications in geophysics.

1987, Spring: Teaching Assistant for Computer Methods in Geological Engineering and for Geotechnical Investigations.

1986, Spring, Summer: Graduate Assistant working on digital image processing and analysis for the Arizona superconducting super collider site investigation.

Fall: Teaching Assistant for Geophysical Engineering.

1984 (summer): Mining Engineer, Pittsburgh and Midway Coal Mining Company, Gallup, NM. Assisted in long range mine planning and exploration including drill rig siting and supervision; electrical resistivity, natural gamma ray and gamma ray well logging; core logging; sampling for assays; computer modeling of coal reserves.

1983 (summer): Hydraulic Engineering Technician, US Army Corps of Engineers, Rock Island, IL. Wrote precipitation routing and flood forecasting computer model for the Des Moines River drainage basin.

1982 (summer): Hydraulic Engineering Technician, US Army Corps of Engineers, Rock Island, IL. Assisted in design of low-head hydroelectric power plants for flood control reservoirs at Coralville, Saylorville, and Red Rock dams in Iowa. Wrote a technical appendix for the Federal Hydropower Reconnaissance Report.

1980-81 (summers): Clerk/Typist for US Army Corps of Engineers, Rock Island, IL. Performed secretarial duties for Hydraulics Branch Chief and Chief of the Engineering Division.

CONSULTING EMPLOYMENT

Mary M. Poulton, sole proprietorship, formerly based in Tucson and now in Mead, WA, for consulting on mine safety. Contracted with GES for consulting with NIOSH Spokane Mining Research Division October 2016 to May 2017, August 2017 to February 2018, August 2018-May 2019. Subcontract to Custos Fratris LLC for consulting in Mexico.

Desert Saber, LLC. New company being created for serious games for mine safety training. Started in January 2017.

GuiaCorp, LLC. New company created for sensor technology. Started in November 2016. US patent pending.

Custos Fratris ("Brother's Keeper") L3C. Senior partner and co-founder 2013 to 2015. Limited profitability, limited liability company based in Tucson, Arizona that focuses on safety training and advanced safety training materials for high-risk occupations. Conduct consulting projects through the company.

NOAH, LLC (Neural Optimization Applied Hydrology), Vice President and co-Founder, 2002 to present. NOAH provides water and energy optimization, prediction, and management technologies for mitigation of supply problems, environmental impacts, water quality, and more. NOAH, LLC received an EPA SBIR award for work in water security. Patent number 7254564 was issued in June 2007.

World Bank – Evaluation of PRODEMINCA geochemical sampling in Ecuador, December 2000, January 2001.

US Bureau of Reclamation – Ground Penetrating Radar survey of Coolidge Dam, for study of the integrity of the spillways and abutments near Globe, Arizona.

HONORS AND AWARDS

2019 Daniel C. Jackling Award from the Society for Mining, Metallurgy, and Exploration

2019 Presidential Citation from Society for Mining, Metallurgy, and Exploration for founding research journal Mining, Metallurgy, and Exploration and serving as initial executive editor

2017 National Engineering Award from American Association of Engineering Societies

2017-2020 SME Board of Directors

2015 SME Ivan B. Rahn Education Award

2013 Eugene Sander Award for Fundraising

2012 SME Distinguished Member

2011 University Research Innovation Award

2010 University Distinguished Professor

2010 Stephen McCann Award for Excellence in Education

2009 American Institute of Mining, Metallurgical, and Petroleum Engineering Industry Educator Award

American Mining Hall of Fame Medal of Merit

2007-08 Udall Center for Public Policy Fellow

2007 Distinguished Lecturer, Arizona Conference of SME, Dec. 11, 2006

2006 Business and Professional Women "Woman of Distinction" Award

1999 UA nominee for national Carnegie Professor of the Year Award

1999 UA Wakonse Fellow

1998, 2011 Excellence at the Student Interface Award

1997 Marquis Who's Who

1997 Strathmore Who's Who

1994 Outstanding Advisor – Center for Off-Campus Students

PUBLICATIONS AND CREATIVE ACTIVITY (>110 PAPERS, REPORTS, CONFERENCE PRESENTATIONS, 7 PAPERS IN PREPARATION; RESEARCH GATE SCORE OF 21.89)

Scholarly Book:

1. Poulton, M., (Ed.), 2001, Computational Neural Networks for Geophysical Data Processing: Pergamon, Amsterdam, 335p.

Symposium Proceedings:

1. King, A., Poate, J., Poulton, M., Duclos, S., Espinal, L., Traversa, E., Mao, S., Baraton, M., 2013, Materials Research Society

Symposium Proceedings: Preface, January, 2013, vol. 1492, Materials Research Society Symposium Proceedings.

National Research Council/National Academies Press

2. Eggert, R., Carpenter, A., Freiman, S., Graedel, T., Meyer, D., McNulty, T., Mougdal, B., Poulton, M., Surgess, L., 2008, Minerals, Critical Minerals, and the U.S. Economy: National Academies Press, Washington, D.C., 245pp.

3. Long, J., Amadei, B., Bardet, J., Christian, J., Glaser, S., Goodings, D., Kavazanjian, E., Major, D., Mitchell, J., Poulton, M., and Santamaria, C., 2006, Geological and Geotechnical Engineering in the New Millennium: National Academies Press, Washington , D.C., 206pp.

Invited Papers:

4. Brown, L., and M. Poulton, 2018, Improving Safety Training through Gamification: An Analysis of Gaming Attributes and Design Prototypes. Human Factors in Engineering *in press*.

5. Poulton, M., S. Jagers, S. Linde, D. Van Zyl, L. Danielson, and S. Matti, 2013, State of the World's Nonfuel Mineral Resources: Supply, Demand, and Socioinstitutional Fundamentals. Annu. Rev. Environ. Resour. 2013. 38:345–71

6. Sweigard, R., and Poulton, M., 2010, "Where Have All the Professors Gone?", vol. 6, Mining Engineering, pg. 6

7. Poulton, M., 2002, Neural networks as an intelligence amplification tool: A review of applications: Geophysics, vol. 67, no. 3, pp. 979-993.

Refereed Journals:

8. Maier, R. M, F. Díaz-Barriga, J. A. Field , J. Hopkins, B. Klein, and M. M. Poulton. 2014. Socially responsible mining: the relationship between mining and poverty, human health and the environment. Rev. Environ Health 29:83-89.

9. Himmel, A., Lazorvitch, N., Poulton, M., Fuhrman, A., Warrick, A., 2010, Neuro-Drip: User-friendly calculator for estimating subsurface wetting patterns for drip irrigation: Irrigation Science, vol 28, pp 535-544.

10. Lazarovitch, N., M. Poulton, A. Warrick, A. Furman, 2009, Water Distribution Under Trickle Irrigation Predicted Using Artificial Neural Networks: Journal of Engineering Mathematics, Vol 64., pp207-218.

11. Coppola Jr., E., Szidarovszky, F., Davis, D., Spayd, S., Poulton, M., Roman, E., 2007, Multiobjective Analysis of a Public Wellfield Using Artificial Neural Networks: Ground Water Vol. 45, No. 1 pp 53–61

12. Szidarovszky, F., E. Coppola, J. Long, A., Hall, and M. Poulton, 2007, A Hybrid Numerical – Artificial Neural Network Model for Ground Water Problems: Ground Water, Vol. 45, No. 5, pp 590-600.

13. Coppola, E., C. McLane, M. Poulton, F. Szidarovszky, and R. Magelky, 2005, Predicting Conductance Due to Upconing Using Neural Networks: Ground Water, Vol. 43, No. 6, pp. 827-836.

14. Coppola, E., F. Szidarovszky, M. Poulton, 2005, Application of Artificial Neural Networks to Complex Groundwater Prediction and Management Problems: Journal of Southwest Hydrology, vol. 4, no 3.

15. Coppola, E., A. Rana, M. Poulton, F. Szidarovszky, and V. Uhl, 2005, A Neural Network Model for Predicting Aquifer Water Level Elevations: Ground Water, Vol. 43, No. 2, pp. 231-241.

16. Coppola, E., F. Szidarovszky, M. Poulton, and E. Charles, 2003, Artificial Neural Network Approach for Predicting Transient Water Levels in a Multilayered Groundwater System under Variable State, Pumping, and Climate Conditions. Journal of Hydrologic Engineering, vol 8, no 6, pp. 348-360.

17. Coppola, E., Poulton, M., Dustman, J., Szidarovszky, F., and Charles, E., 2003, Application of neural networks to complex groundwater problems: Journal of Natural Resources, vol 12, no. 4, pp. 303-320.

18. Zhang, L., Poulton, M., and Wang, T., 2002, Borehole electrical resistivity modeling using neural networks: Geophysics, vol. 67, no. 6, pp. 1779-1789.

19. Buffenmyer, V., Poulton, M., and Johnson, R., 2000, Identification of seismic crew noise in marine surveys by neural networks: The Leading Edge, vol. 19, no. 4, pp. 370-377.

20. Birken, R., M. Poulton, and K. Lee, 1999, Neural network interpretation of high-frequency electromagnetic ellipticity data part I: Understanding the half-space and layered-earth response: Jour. Of Environmental and Engineering Geophysics, vol. 4, no. 2, pp. 93-104.

21. Birken, R., and M. Poulton, 1999, Neural network interpretation of high-frequency electromagnetic ellipticity data part II: Analyzing 3D responses: in Jour. Of Environmental and Engineering Geophysics, vol. 4, no. 3, pp. 149-165.

22. Poulton, M., and R. Birken, 1997, Estimating one-dimensional models from frequency-domain electromagnetic data using modular neural networks: IEEE Geoscience and Remote Sensing Journal, vol. 36, no. 2, pp. 547-555.

23. Brown, M., and M. Poulton, 1996, Locating buried objects for environmental site investigations using neural networks: Jour. Of Environmental and Engineering Geophysics, vol. 1, no. 3, pp. 179-188.

24. Poulton, M., B. Sternberg, and C. Glass, 1992, Location of subsurface targets in geophysical data using neural networks: Geophysics, vol. 57, no. 12, pp. 1534-1544.

25. Poulton, M., B. Sternberg, and C. Glass, 1992, Neural network pattern recognition of subsurface EM images: Journal of Applied Geophysics, vol. 29, pp. 21-36.

26. Poulton, M., B. Sternberg, and I. Farmer, 1991, In situ strength measurements of weak rocks: ASCE Journal of Geotechnical Engineering, vol. 117, no. 9, pp. 1424-1429.

27. Kulatilake, P., D. Wathugala, M. Poulton, and O. Stephanson, 1990, Analysis of structural homogeneity around the ventilation drift at the Stripa Mine: International Journal of Engineering Geology, vol. 29, pp. 195-211.

Refereed Book Chapters:

28. Poulton, M., 2002, Mineral Uses and Consumption *in* EarthInquiry: W.H. Freeman and Company (www.whfreeman.com/earthinquiry) (hard copy and electronic versions)

29. Zhang, L., and Poulton, M., 2001, Neural network inversion of EM39 induction log data: accepted *in* B. Sandham and M. Leggett (Eds), Geophysical Applications of Artificial Neural Networks and Fuzzy Logic: Kluwer Academic Publishing, Netherlands.

30. Poulton, M., and J. Kemeny, 2000, A Model For Integrating Technology Preceptors In The Classroom: *in* J. Miller (Ed) Student Assisted Teaching And Learning: Anker Publishing.

31. Poulton, M., M. Brown, T. Larson, and R. Callow, 1995, Hazardous waste site characterization using virtual environments and neural networks, accepted *in* Wang, F., and Lever, P. (Eds) Advances in Robotics and Automates Systems for Hazardous Environments: World Scientific Publishers.

32. Williamson, R., and M. Poulton, 1994, The geology of the Mineral Hill area, Mission Mine, Pima County, Arizona, *in* Pierce, F., Bohm, J. (Eds) Porphyry Copper Deposits of the American Cordillera: Arizona Geological Survey Digest 20, pp. 442-454.

33. Sternberg, B., M. Poulton, and S. Thomas, 1990, Geophysical investigations in support of the Arizona SSC project: in S. Ward (Ed) Environmental and Engineering Geophysics: SEG, Tulsa, OK.

Invited Technical Presentations with Conference Papers:

1. Poulton, M., R. Birken, and L. Zhang, 1997, Integrating neural networks in field interpretations for environmental geophysics surveys: Proceedings, Workshop on Geophysical Applications of Artificial Neural Networks and Fuzzy Logic, 59th EAGE Conference, May 26, Geneva, Switzerland.

2. Sternberg, B., and M. Poulton, 1996, The LASI High-frequency Electromagnetic Subsurface Imaging System: System description and demonstration site characterization survey at the Idaho National Engineering Laboratory: Proceedings from the Industry Partnerships to Deploy Environmental Technology Meeting: DOE Morgantown Energy Technology Center, Morgantown, WVA, Oct. 22-24.

3. Poulton, M., 1994, Neural networks applied to problems in the geosciences: UA Neural Network Workshop, April 23, Tucson, AZ.

4. Poulton, M., 1993, Toward real-time interpretation with neural networks: Range Cleanup Workshop, Naval Post Graduate School, March 23-25, Monterey, CA.

Conference Proceedings (with some level of peer review):

1. Poulton, M., 2015, The New Face of Mining – Industry-University Research Partnerships, SME Annual Meeting, Feb. 17, 2015, Denver, CO

2. Poulton, M., 2015, How many anthropologists does it take to build a mine?, SME Annual Meeting, Feb 16, 2015, Denver, CO

3. Heath, G., Poulton, M., Momayez, M., Stoll, K., 2014, Remote Controlled Monitoring For Closure Of The Carlota Mine *2014 AIPG/AHS - Water and Rocks, the Foundations of Life National Conference*, Sept 15-16, Prescott, AZ

4. Poulton, M., 2014, Mining Engineering Research – To Be, or Not To Be, SME Annual Meeting, Salt Lake City, UT

5. L. Brown, R. Hill, M. Poulton. MineSAFE: A New Software Architecture for Mine Safety Education, 2013, SME Annual Meeting, Denver, CO

6. K. Galla, S. Dessureault, M. Poulton, S. Annavarapu. Commerce and Sustainability of Mining Sector in India, 2013, SME Annual Meeting, Denver, CO

7. W.P. Rogers, M. Poulton, S. Dessureault, Social license and mineral economics: new modeling approaches, 2013, SME Annual Meeting, Denver, CO

8. M. Poulton and P. Mather. “ iSustain: a data warehouse for sustainable resource development analyses”, 2013, SME Annual Meeting, Denver, CO

9. Freeman, L., and Poulton, M., 2012, Integrating the workforce value chain to solve our talent shortage. HRMining, Nov 7, Santiago, Chile

10. Poulton, M., 2012, Integrating Interdisciplinary Mining Technology Research from Nano-scale to Terrabytes. PeruMin 2013, Lima , Peru

11. Poulton, M., 2012, Analysis of the Mining Engineering Faculty Pipeline: SME Annual Meeting, Seattle, WA, February

12. Poulton, M., 2012, Patching the Workforce Pipeline: A Model for Building Workforce Capacity for Industry and Academia: SME Annual Meeting, Seattle, WA, February

13. Poulton, M., 2011, The Ruptured Pipeline: Workforce Issues in the Mineral Resources Professions: AGU Annual Meeting, San Francisco, CO, December

14. Poulton, M., 2011, Creating an Interdisciplinary Research Organization for Sustainable Development of Critical Earth Materials, Society of Mining Professors Annual Meeting, Arequipa, Peru, September 12.

15. Poulton, M., 2011, The Demographic Earthquake: How to Address Workforce Capacity in the Mineral Resources Professions, Society of Mining Professors Annual Meeting, Arequipa, Peru, September 14

16. Snyder, D., Prouty, M., George, D., King, T., Poulton, M., Szidarovszky, A., 2010, UXO discrimination at Camp San Luis Obispo with the metalmapper, Proceedings of the Symposium on the Application of Geophysics to Engineering and Environmental Problems, SAGEEP, pp 1054-1064,

17. Szidarovszky, A., M. Poulton, S. MacInnes, 2008, Identification of unexploded ordnance from clutter using neural networks: Society of Exploration Geophysicists Annual Meeting, Nov 11-14, Las Vegas, NV. (invited paper as best paper from SAGEEP 08 meeting)

18. Szidarovszky, A., M. Poulton, S. MacInnes, 2008, Identification of unexploded ordnance from clutter using neural networks: Symposium on the Application of Geophysics to Engineering and the Environment (SAGEEP), April 6, Philadelphia, PA.

19. Lazarovitch, N., M. Poulton, A. Furman, A. Warrick, 2006, A User-Friendly Program for Estimating Subsurface Wetting Patterns: First International From Research Institutes to the Water Industry, Ben Gurion University, Nov 28-30, 2006, p. 57-61, Sede Boqer, Israel.

20. Coppola, E. Jr., J. Dustman, M. Poulton, F. Szidarovszky. Optimal Wellfield Energy Efficiency Using an Automatic Data Collection System and Artificial Neural Network Technology. Proc., An AEESP Symposium:

Frontiers in Assessment Methods for the Environment, University of Minnesota, Coffman Nemorial Union, Aug. 10-13, 2003, p. 93.

21. Coppola, E. Jr., A. J. Rana, M. Poulton, F. Szidarovszky, V. Uhl. Artificial Neural Network Approach for Accurately Predicting Groundwater Levels. Proc., American Water Resources Association 2003 International Congress, New York City, N.Y., June 29 – July 2, 2003, on CD-Rom in Session: Ground Water Perspectives.

22. Coppola, E., McClane, C., Poulton, M., Szidarovszky, F., Magelky, R., 2004, Artificial Neural Network Modeling of Saltwater Upconing, American Water Resources Association 2004 Annual Conference.

23. Coppola, E., Poulton, M., Szidarovszky, F., Charles, E., McClane, C., Magelky, R., and Woods, H., 2004, Artificial Neural Network Applications to Water Resources Management Problems, Arizona Hydrologic Society Meeting, Tucson, AZ.

24. Coppola, E., Woods, H., Poulton, M., Szidarovszky, F., 2004, Forecasting Water Consumption for a Large Water Utilityusing Artificial Neural Networks, American Water Resources Association 2004 Annual Conference.

25. Hunter, R., Wilson, Scott, Casavant, R., Johnson, R., Poulton, M., Glass, C., Mallon, K., Patil, S., Dadekar, A., Collett, T., 2004, Reservoir-Fluid Characterization and Reservoir Modeling of Potential Gas Hydrate Resources, Alaska North Slope: AAPG Annual Meeting, Dallas, TX, April 18-23.

26. Salazar, R., Coppola, E., Rojano, A., Poulton, M., Szidarovszky, F., 2004, Forecasting Solar Radiation with Artificial Neural Networks, American Water Resources Association 2004 Annual Conference.

27. Snyder, D., MacInnes, S., Hare, J., Grimm, R., Poulton, M., Szidarovszky, A., 2004, The value of multi-component TEM data for the estimation of UXO target parameters: SAGEEP04, Colorado Springs, CO, Feb. 22-25.

28. Moreno, R., Coppola, E., Poulton, M., Szidarovszky, F., and Jacinto, A., 2003, An artificial neural network approach for forecasting available reservoir water storage for irrigation in a semi-arid region: AWRA 2003 Annual Water Resources Conference, Nov 3, San Diego, CA.

29. Coppola, E. Rana, A., Poulton, M., Szidarovszky, F., and Uhl, V., 2003, Artificial Neural Network Approach for Accurately Predicting Groundwater

Levels: American Water Resources Association 2003 International Congress, Watershed Management for Water Supply Systems, New York City, NY. June 29-July 2, 2003.

30. Coppola, E., Dustman, J., Poulton, M., and Szidarovszky, F., 2003, Optimizing Wellfield Energy Efficiency using an Automatic Data Collection System and Artificial Neural Network Technology: Frontiers in Assessment Methods for the Environment, Minneapolis, Minnesota. August 10-13, 2003.

31. Hunter, R., Digert, S., Casavant, R., Johnson, R., Poulton, M., Glass, C., Mallon, K., Patil, S., Dandekar, A., and Collett, T., 2003, Resource characterization and quantification of natural gas-hydrate and associated free-gas accumulations in the Prudhoe Bay – Kuparak River area on the north slope of Alaska: AAPG Annual Meeting, Salt Lake City, UT, May 11-14, 2003. *Received 2nd Place for President's Award for Outstanding Poster Presentation.*

32. Poulton, M., 2003, Searching for the next generation of mineral resources professionals: A resistive target: Prospectors and Developers Association of Canada International Convention, Trade Show, and Investors Exchange, Toronto, Canada, March 9-12, 2003.

33. Salazar, R., Poulton, M., Coppola, E., Szidarovszky, F., and Jacinto, A., 2003, An Artificial Neural Network Approach for Forecasting Available Reservoir Water Storage for Irrigation in a Semi-Arid Region: American Water Resources Association Annual Conference, San Diego, California. November 3-6, 2003.

34. Coppola, E., Poulton, M., Szidarovszky, F., Charles, E., 2002, Development of a CNN for better understanding the seasonal responses of a glacial-filled aquifer to variable climate and pumping conditions: Symposium on the Application of Neural Networks to the Earth Sciences, Seventh International Symposium on Mineral Exploration, August 20-21, San Jose, CA.

35. Hunter, R., Pelka, G., Digert, S., Casavant, R., Johnson, R., Poulton, M., Glass, C., Mallon, K., Patil, S., Chukwu, G., Dandekar, A., Khataniar, S., Ogbe, D., and Collett, T., 2002, Resource characterization and quantification of natural gas-hydrate and associated free-gas accumulations in the Prudhoe Bay – Kuparak River area on the north slope of Alaska: Joint Conference of AAPG Pacific Section and SPE Western Region, May 18-23, 2002, Anchorage, AK.

36. Rucker, D., Poulton, M., and Ferre, P., 2002, A Back Propagation Neural Network for Processing First-Break Picks in Cross Borehole Ground Penetrating Radar: GPR2002 Symposium, Santa Barbara, CA, April 29-May 2.

37. El-Kaliouby, H., Hussain, S., El-Diwany, E., Hashish, E, Bayoumi, A., and Poulton, M., 2001, Forward modeling and inversion of IP effects in TEM response using measured rock samples data: SEG Expanded Abstracts, 71st International Society of Exploration Geophysicists meeting, Houston, TX.

38. Potts, K., and Poulton, M., 2001, Neural network classification of water content for agglomeration processes: Mine Planning and Equipment Selection conference, New Delhi, India, Nov 19-22, p. 495-504.

39. Buffenmyer, V., Poulton, M., Johnson, R., and Spitz, S., 1999, Neural network approach to seismic crew noise identification in marine surveys: SEG Expanded Abstracts, 69th International Society of Exploration Geophysicists meeting, Houston, TX.

40. El-Kaliouby, H., and Poulton, M., 1999, Inversion of coincident loop TEM data for layered polarizable ground using neural networks: SEG Expanded Abstracts, 69th International Society of Exploration Geophysicists meeting, Houston, TX.

41. El-Kaliouby, H., and M. Poulton, 1999, Computational intelligence techniques for TEM inversion: SEG 1999 Summer Research Workshop on Geoinversion: Model-based Inversion Challenges the Technology Transfer, August 1-6, Taos, NM.

42. Zhang, L., Poulton, M., Mezzatesta, A., 1999, Neural network based layer picking for unfocused resistivity log parameterization: SEG Expanded Abstracts, 69th International Society of Exploration Geophysicists meeting, Houston, TX.

43. Zhang, L., Poulton, M., Zhang, Z., Mezzatesta, A., and Chakravarthy, S., 1999, Fast forward modeling simulation of resistivity well logs using neural networks: SEG Expanded Abstracts, 69th International Society of Exploration Geophysicists meeting, Houston, TX.

44. Mullen, S., M. Poulton, H. Brooks, and T. Hamill, 1998, Post-processing of the ETA/RSM ensemble forecasts by a neural network: 78th Annual American Meteorological Society, First Conference on Artificial Intelligence, Phoenix, pp. J31-J40.

45. Birken, R., and M. Poulton, 1997, Estimating resistivity and dielectric constant from high-frequency electromagnetic ellipticity data using neural networks: Proceedings, High-Resolution Geophysics Workshop, Jan6-8, Tucson.

46. Birken, R., and M. Poulton, 1997, Neural network interpretation of high-frequency electromagnetic ellipticity data: Symposium on the Applications of Geophysics to Engineering and Environmental Problems, March 23-26, Reno.

47. Zhang,L., and M. Poulton, 1997, Neural network interpretation of EM39 well log data: Symposium on the Applications of Geophysics to Engineering and Environmental Problems, March 23-26, Reno.

48. Birken, R., M. Poulton, and B. Sternberg, 1996, Physical modeling of small shallow conductive 3D targets with high-frequency electromagnetics: Environmental and Engineering Geophysics Society European Section Meeting, Nantes, France, Sep. 2-5.

49. Birken, R., and M. Poulton, 1995, Neural network interpretation scheme for frequency-domain electromagnetic ellipticity surveys: Symposium on the Applications of Geophysics to Engineering and Environmental Problems, April 23-26, Orlando, FL.

50. Brown, M., and M. Poulton, 1995, Neural network interpretation with electromagnetic and magnetic data for environmental site investigations: Symposium on the Applications of Geophysics to Engineering and Environmental Problems, April 23-26, Orlando, FL.

51. Sternberg, B., and M. Poulton, 1994, High-resolution subsurface imaging and neural network recognition: Symposium on the Applications of Geophysics to Engineering and Environmental Problems, March 27-31, Boston, MA.

52. Sternberg, B., and M. Poulton, 1994, High-resolution subsurface imaging and neural network recognition: Unexploded Ordnance Detection And Range Remediation Conference, May 17-19, Golden, CO.

53. Ashley, D., and M. Poulton, 1993, Geophysical target identification in environmental investigations: in Intelligent Engineering Systems Through Artificial Neural Networks, vol. 3, Proceedings of the Artificial Neural Networks in Engineering Conference, pp. 903-908.

54. Kemeny, J., and M. Poulton, 1993, Minerals, Where and Why: A multimedia computer program for minerals education: AGU Fall Meeting, Dec. 6-10, San Francisco, CA.

55. Poulton, M., and D. Labrecque, 1993, Neural network based inversion: Theory and application: International Workshop on Airborne Electromagnetic Methods, Sept. 13-16, Tucson, AZ.

56. Poulton, M., and K. Zaverton, 1992, Comparison of neural network paradigms for classification of TM images: 23rd International Symposium on the Application of Computers and Operations Research in the Minerals Industry, pp. 37-46.

57. Poulton, M., and A. El-Fouly, 1991, Pre-processing GPR signatures for cascading neural network classification: SEG Expanded Abstracts, 61st International Society of Exploration Geophysicists meeting, Houston, TX, pp. 507-509.

58. Poulton, M., 1991, Comparison of accuracy and sensitivity of neural network parameter estimation paradigm for EM subsurface images: SEG Expanded Abstracts, 61st International Society of Exploration Geophysicists meeting, Houston, TX, pp. 299-301.

59. Glass, C., B. Sternberg, and M. Poulton, 1990, Continuous profiling subsurface monitoring using adaptive pattern recognition: Proceedings from the International Symposium on Mine Mechanization and Automation, Vol. II, June 10-13, 1991.

60. McGill, J., B. Sternberg, G. Glass, and M. Poulton, 1990, GPR Research at the University of Arizona: Third International Conference on Ground Penetrating Radar, May 14-18 Lakewood, Co.

61. Poulton, M., B. Sternberg, and C. Glass, 1990, Continuous-output neural networks for EM ellipticity pattern recognition: IEEE 10th Annual International Geoscience and Remote Sensing Symposium, May 20-24, Washington, D.C., pp. 1297-1300.

62. Poulton, M., C. Glass, and B. Sternberg, 1989, Recognizing EM ellipticity patterns with neural networks: SEG Expanded Abstracts, 59th International Society of Exploration Geophysicists meeting, October 30-November 2, Dallas, TX, pp. 208-211.

Technical Reports:

1. Poulton, M., 2016, Effective Mining Safety Training: Design, Implementation, and Evaluation: submitted to Alpha Foundation for the Improvement of Mine Safety and Health

2. Poulton, M., Barton, M., Burgess, J., 2013, Sustainable development of critical earth materials: submitted to Science Foundation Arizona

3. Poulton, M., 2013, Improving Mine Emergency Prevention using Computer Software Simulations: submitted to MSHA

4. Poulton, M., Cassavant, R., Johnson, R., 2010, Analysis of methane hydrate resources in the Milne Point area, North Slope Alaska: submitted to BP-Alaska

5. Poulton, M., and L. Zhang, 1999, Neural network interpretation of well log data: Final Report to Baker-Atlas Logging Services, 111 pp.

6. Poulton, M., and V. Buffenmyer, 1999, Neural network approach to seismic crew noise identification in marine surveys: Final Report to CGG, 42 pp.

7. Sternberg, B., and M. Poulton, 1997, High-resolution subsurface imaging and neural network recognition: non-intrusive buried substance location: Final report on DOE contract DE-AC21-92MC29101-A001, 172 pp.

8. Geophysics Field Camp, 1996, Geophysical surveys in Hidalgo and Grant Counties, NM: LASI-96-1, 52pp.

9. Sternberg, B., and M. Poulton, 1996, LASI ellipticity survey at the Nevada Test Site: Final report on Sandia contract AS-2042-0144.

10. Birken, R., and M. Poulton, 1995, Data visualization and interpretation software: Final contract report for USBM contract J0220004, 35 pp.

11. Geophysics Field Camp, 1995, Geophysical Surveys in Pima County: LASI-95-1, University of Arizona, 77 pp.

12. Poulton, M., and D. Ashley, 1995, One-dimensional neural network interpretation of EM ellipticity data in the frequency range 1 kHz to 1 MHz: Final contract report for USBM contract J0220004, 124 pp.

13. Sternberg, B., and M. Poulton, 1995, Identifying Subsidence Hazards Using a Unique High-Resolution EM System and Neural Network Interpretation: Final contract report for USBM contract J0220004, 86 pp.

14. Geophysics Field Camp, 1994, Geophysical Surveys in Cochise County: LASI-94-1, University of Arizona, 62 pp.

15. Poulton, M., and M. Brown, 1994, Feasibility Study on the Applicability of Artificial Neural Networks for the Interpretation of Dig-Face Data: Final contract report for LITCO contract C85-110751, 151 pp.

16. Sternberg, B., M. Miletto, D. Labrecque, S. Thomas, and M. Poulton, 1991, The Avra Valley Geophysical Test Site: LASI-91-2, University of Arizona, 56 pp.

17. Swindle, T., C. Glass, and M. Poulton, 1990, Mining Lunar Soils for He^3: NASA Space Engineering Research Center Report TM-90/1, University of Arizona, 99 pp.

18. Sternberg, B., J. Esher, and M. Poulton, 1988, Report on Seismic Surveys During December 1987 and January 1988 for the Arizona SSC Maricopa Site: LASI-88-1, University of Arizona, 253 pp.

Invited Presentations (conference and non-conference related)

More than 125 presentations on IMR research to numerous companies and politicians and speeches to civic and business groups since 2010 not listed here.

Keynote Speeches:

1. 102 Uses for a Hole in the Ground: Committee on Earth Resources, National Academies, Meeting on Exploring Partnerships to Convert Liabilities to

Assets: Opportunities with Inactive and Abandoned Mined Lands in the US, April 10, 2017

2. Resourcing the Material World: Balancing Material and Societal Demands: ISES Conference, Oct. 18, 2015, Las Vegas, NV
3. Successful Change Management for University Mineral Resources Programs: Business Process Improvement in Mining Conference, December 3, Tucson, AZ
4. The New Face of Mining: The Culture Change for Compatible Mining, Dec 7, 2015, Arizona Conference of SME, Tucson, AZ

Invited Talks:

5. Poulton, M. and Barton, M., 2015, AZ 101: Mineral Resources, tutorial on mining for staffs of city, county and mayoral officials, Nov. 18, 2015, Tucson
6. Poulton, M., 2015, Satisfying the Material World: The Challenges of the 21st Century, ASU Singulair Project, July 20, 2015, Phoenix, AZ
7. Poulton, M., 2014, Social License for Mining as a Necessary Part of the Business Plan, Latin American Conference on Compatible Mining: Protecting Vulnerable Populations and the Surrounding Environment September 8-10, 2014, San Luis Potosi, Mexico
8. Mary Poulton, 2014, Faculty Pipeline: A Reverse Commute. Invited Presentation. SME Educator's Forum, SME Annual Meeting, Salt Lake City, UT.
9. Poulton, M., 2013, Transfer of Data Management Technology from Municipal Well Fields to the Mining Industry, Global Mining Water Management Initiative, January 30-31, 2013, Las Vegas, NV
10. Poulton, M., 2012, Transfer of data management technology from municipal well fields to the mining industry: invited talk, IQPC Water management in mining summit, Denver, July 24-25
11. Mary Poulton, 2012, "Analysis of the Engineering Faculty Pipeline", t SME annual meeting, Seattle, WA, February 20, 2012
12. Mary Poulton, 2012, "Patching the Workforce Pipeline: A model for building workforce capacity for industry and academia", SME annual meeting, Seattle, WA, February 20, 2012
13. Poulton, M., 2012, "Analysis of the Mining Engineering Faculty Pipeline": SME Annual Meeting, Seattle, WA, February 20, 2012
14. Freeman, L., and Poulton, M., 2012, Integrating the workforce value chain to solve our talent shortage. HRMining, Nov 7, Santiago, Chile
15. Poulton, M., 2012, Integrating Interdisciplinary Mining Technology Research from Nano-scale to Terrabytes. Accepted for PeruMin 2013, Lima , Peru
16. Mary Poulton, 2011, Mining Engineering Distance Education, SME Educators Forum, SME Annual Meeting, Denver, CO, Feb 25, 2011

17. Mary Poulton and Eric Lutz, IMR Mine Safety Research, Joint Meeting of Arizona Rock Products Association and Arizona Mining Association Meeting, January 13, 2011, Phoenix
18. Distance Education at the University of Arizona, SME Annual Meeting, 2011
19. Mary Poulton, 2011, "The Ruptured Pipeline: Analysis of the Mining Engineering Faculty Pipeline", AGU, San Francisco, CA, December 5, 2011
20. Mary Poulton, 2010, Mining Industry Research: Funding and Legislative Update, SME Faculty Forum, SME Annual Conference, Phoenix, AZ, February 28, 2010
21. Mary Poulton, 2010, Mining Faculty Pipeline Issues, Mining Department Heads Meeting, SME Annual Conference, Phoenix, AZ, February 28, 2010
22. Mary Poulton, 2009, Overview of the Lowell Institute for Mineral Resources, SME-Arizona Conference, December 7, 2009, Sheraton El-Conquistador, Tucson.
23. University Economics 101, SME Annual Meeting, Feb 27, 2007
24. Mamas, Let Your Babies Grow Up to Be Mining Engineers, National Minerals Education Conference, Oklahoma City, OK, June 26, 2007 and SME Annual Meeting, Feb 28, 2007, Denver, CO
25. Educating the Minds of the Future to Build the Mines of the Future, SME Leadership Conference, Park City, UT, June 27, 2007
26. Educating the Minds of the Future to Build the Mines of the Future, SME, Gila Valley Section, Safford, AZ, February 8, 2006; SME Morenci Section, January 10, 2006, SME Tucson Section, January 11, 2006
27. Invited lectures at Chengdu Institute of Technology, Chengdu China, March 2004.
28. New Jersey Department of Environmental Protection, NJ Geological Survey, September 8, 2003
29. Norwegian University of Science and Technology, Trondheim, Norway, December 2, 2002
30. Geosciences Department Seminar, University of Arizona, October 31, 2002
31. Applied Math Seminar, University of Arizona, April 25, 2002
32. University of Arizona Assessment Symposium "Measuring Success: Taking Responsibility for Learning at the University of Arizona", Case Studies at the Department Level Session. Presentation on accreditation process in MGE Department, March 28, 2002
33. Methane Hydrate: A new source of natural gas, Women's Auxiliary of AIME, January 17, 2002
34. Geophysics Applications of Neural Network Research, Idaho National Engineering and Environmental Laboratory, July 31, 2001
35. Introduction to neural networks, and reservoir characterization with neural networks, Petrobel (Egyptian National Oil Company), Cairo, Egypt, March 29, 2001

36. Michigan Technological University Department of Geological Engineering and Sciences, February 1,2, 2001
37. Oklahoma University Department of Geology and Geophysics, November 14, 2000
38. State of Minerals Education at the UA, Mining and Metallurgical Society of America, Arizona Section, October 18, 2000
39. 1999 Arizona Wakonse Teaching Retreat – The UA Teaching Teams Program, June 4, 1999.
40. 1999 Arizona Wakonse Teaching Retreat – Webpage design for a general education science course, June 5, 1999.
41. Technology-enabled learning – Can we get there from here, presented at UA Technology in Education Forum, April 27, 1998.
42. Graduate Seminar, Department of Material Science and Mineral Engineering, UC Berkeley, September 11, 1997.
43. Engineering 196h, December 1, 1997.
44. Minerals, Where and Why – USA, Fifth Annual International Minerals Education Conference, Scottsdale, June 22, 1996.
45. Lawrence Berkeley Laboratory, Berkeley, CA, June 7, 1996.
46. UA Science Teachers' Colloquium Series, UA, (3 hour presentation on neural networks), April 25, 1996.
47. Bechtel/INEL Joint Workshop on Advanced Simulation and Training, San Francisco, CA, April 4-5, 1995.
48. Naval Surface Warfare Center, Indian Head, MD, Sept. 28, 1993.
49. Idaho National Engineering Laboratory, Idaho Falls, ID, Jan. 28, 1993.
50. Department of Energy, Morgantown, WVA, Dec. 2, 1992.
51. Seminar for visitors from Leningrad Mining Institute, Dec. 17, 1991.
52. Leningrad Mining Institute, Leningrad, USSR, May 22, 1991.

GRANTS AND CONTRACTS ($27,111,712)

Government Sponsored Technical Research:

Western Mining Safety and Health Resource Center: Translating Training to Competency: NIOSH, 9/1/14 – 8/31/17, $1.36M. Role-PI.

Improving Miner Preparedness and In-emergency Resiliency Using Multi-Player Mine Emergency Response Simulations: MSHA Brookwood Sago, 10/1/14-9/30/15, $136,906. Role-PI.

Building the Latin America Natural Resources Academy: 100,000 Strong in the Americas Project, 1/1/14-4/1/17, $60,000. Role-PI. 100% Effort. – Inaugural grant for President Obama's signature education initiative. Grant was announced at reception in Washington DC by US Vice President Joseph Biden and Secretary of State John Kerry on January 17, 2014.

Carlota Advanced Monitoring System: KGHM International, 2/3/14 – 2/1/16, $418,229. Role-PI. (technology commercialized as Sub Rosa LLC)

Effective Mining Safety Training - Design, Implementation, and Evaluation: The Alpha Foundation for Improvement of Mine Safety and Health, 11/1/13 – 10/31/15, $663,817. Role-PI.

Western Mining Safety and Health Resource Center: NIOSH, 9/1/10 – 8/31/14, $1.9M. Role-PI.

Testing and Evaluation of Computer Software Simulations for Mine Emergency Preparedness: MSHA, 10/1/12-9/30/13, $167,191. Role-PI.

Improving Mine Emergency Prevention using Computer Software Simulations: MSHA, 10/1/11 – 3/31/13, $122,449. Role-PI.

Sustainable development of Critical Earth Materials: Science Foundation Arizona and industry matching funds, 1/1/09- 12/31/12, $17.8M. Role- PI.

Multi-dimensional infiltration and distribution of water of different qualities and solutes related through artificial neural networks: United States-Israel Binational Agricultural Research and Development Fund, 9/1/05-5/31/09, $130,000. Role-co-PI (A. Warick, SWES PI).

Improved hydrologic assessment of recharge beneath ephemeral streams: applications in arid areas: NSF, US-Egypt Cooperative Research, 9/1/03-8/31/05, $24,000. Role=co-PI (P. Ferre, HWR PI).

Resource characterization and quantification of natural gas-hydrate and associated free-gas accumulation in the Prudhoe Bay – Kuparuk River area on the North Slope of Alaska: DOE (BP subcontract to UA), 11/2002 – 12/2008, $1,235,152. Role=PI, (R. Johnson, (Geos), R. Casavant, C. Glass, co-PIs).

Building a partnership for sustainable natural resource development in China: AAAS, 5/1/03-5/12/04, $5,000. Role=PI.

UXO classification using a static TEM antenna array: SERDP, 5/29/03-12/31/05 (Zonge subcontract to UA), $46,893. Role=PI.

Neural network interpretation of seismic attributes: NSF, 7/1/99-6/30/02, $74,800. Role=PI.

Application of geomechanics and geophysics to solve environmental problems: NSF, 6/1/99-5/31/03, $247,059. Role=PI (co-PI at time of submission, PI after departure from UA by Dr. Harpalani,).

Geophysical electromagnetic prospecting for groundwater and economic minerals: NSF 9/1/99 - 8/31/01, $20,000. *This was the US part of a $50,000 joint proposal from the US State Department US-Egypt Joint Science and Technology Program. I wrote the full proposal. Role=PI.

Neural network interpretation of TEM data and support for visiting scholar Hesham El-Kaliouby: Funded by Egyptian Government, 10/98-10/00, $10,500.

Mesoscale predictablility and improvement of ensemble forecasts and predictions using neural networks: Funded by Office of Naval Research, 1998-2000, $51,248. Role=co-PI (S. Mullen (Atmos), PI).

LASI ellipticity survey of the Nevada Test Site: Funded by Sandia National Lab, 2/1 - 6/30/96, $23,840. Role=co-PI (B. Sternberg, PI).

High-resolution subsurface imaging and neural network recognition for non-intrusive buried substance location: Funded by Department of Energy, 10/92 - 1/97, $681,863. Role=co-PI (B. Sternberg, co-PI).

Identifying subsidence hazards with a unique high-resolution EM system and neural network interpretation: Funded by US Bureau of Mines, 4/92 - 4/95, $199,952. Role=co-PI (B. Sternberg, co-PI).

Subsurface void detection with a unique high-resolution EM system and neural network interpretation: Funded by US Army, 9/92 - 10/94, $199,885. Role=co-PI (B. Sternberg, PI).

Study of gold and copper mineral deposit classes using neural networks: Funded by University of Arizona, 1/92 - 12/92, $3,000. Role=PI.

Estimation of moisture content of mine tailings from spectral reflectance values for prediction of blowing dust hazard. Funded by US Bureau of Mines, Arizona Mining and Mineral Resources Research Institute, 6/91 - 5/92, $17,099. Role=PI.

Study of the pre-processing requirements of neural networks. Funded by US Bureau of Mines, Arizona Mining and Mineral Resources Research Institute, 6/90 – 5/91, $17,412. Role=PI.

Industry Sponsored Technical Research:

Neural network approach to seismic crew noise identification in off-shore surveys. Funded by CGG, Houston, TX, 12/28/99-12/27/00, $33,347. Role=PI (Roy Johnson (Geos), co-PI).

Neural network interpretation of wireline logs. Funded by Baker-Atlas Logging Services, 9/1/97-6/15/99, $42,475. Role=PI.

Neural network feasibility study using dig-face characterization data: Funded by Lockheed Idaho Technologies Corp. 6/1 - 12/15/94, $28,222. Role=PI.

Testing the LASI high-resolution subsurface-imaging ellipticity system: Electric Power Research Institute, 8/91-12/92, $59,894. Role=co-PI (B. Sternberg, PI, M. Sully (HWR), S. Neumann (HWR), co-PIs).

Education Research:

Minerals, Where and Why: Web, Funded by Mining and Metallurgical Society of America, 4/00-4/01, $5,000. Role=co-PI (J. Kemeny, co-PI).

Girls in the SYSTEM (Sustaining Youth in Science, Technology, Engineering, and Mathematics), Funded by NSF, 9/1/99-8/31/03, $819,216. Role=co-PI (M. Civil (Math), PI, K. Mangin (EEB), S. Seraphin (MSE), J. Monk (SIROW), co-PIs).

Teaching web skills in a Nats 101 course, Funded by UA New Learning Environments and Instructional Technologies Grants Program, 7/1/99- 6/30/00, $6,000. Role=co-PI (J. Kemeny, co-PI).

The teaching teams program: a top-down, bottom-up strategy for improving the delivery of general education faculty-undergraduate collaboration, Funded by FIPSE and Kellogg Foundation, 9/1/98-8/31/00, $374,000. Role=co-PI (H. Larson (LPL), was sole PI but proposal was written and project was co-managed by myself and R. Mencke (ULC), S. Mioduski (ULC), C. Walker (ASTR), J. Kemeny (MGE), B. Harrison (UTC)).

Development of web-based modules to facilitate learning in a Nats 101 course, Funded by UA New Learning Environments and Instructional Technologies Grants Program, 6/1/98-5/31/99, $14,683. Role=co-PI (J. Kemeny, co-PI),

Support for CD conversion to web for Nats101, Funded by UA New Learning Environments and Instructional Technologies Grants Program, 5/98, $2,000. Role=co-PI (J. Kemeny, co-PI).

ABET2000 Course upgrade proposal for MGE 200 and 219, Funded by UA College of Engineering and Mines, 8/98, $15,000, role=PI.

Building two-way streets: women and scientific literacy, Funded by AAC&U, 1/1/97-12/31/99, $38,000 (B. Subramanian and L. Briggs, were co-PIs; I was involved in project management and execution but not in the proposal writing. I have not included this in my total funding amount.).

Development of Minerals, Where and Why –South Africa, Funded by South African Institute for Mining and Metallurgy, 12/96-11/99, $5,000. Role=co-PI (J. Kemeny, co-PI).

Faculty Development Grant, 1995-96. Develop computer tutorials for G EN 120 class: $7,980. Role=PI.

Instructional Technology Grant, 1995-96. Develop multimedia lab for G EN 120 class: $21,000. Role=co-PI, (J. Kemeny, co-PI).

BHP Minerals. Support for G EN 416 class. 1994 - $5,000. 1995 - $6,500. 1996 - $7,000. Role=PI.

Mining and Metallurgical Society of America, 1994-95. PC version of "Minerals, Where and Why - USA": $6,000. Role=co-PI (J. Kemeny, co-PI).

US Bureau of Mines, 1992-93. US version of "Minerals, Where and Why" computer program: $12,000. Role=co-PI (J. Kemeny, co-PI).

Arizona Mining Association, 1991-92. Arizona version of “Minerals, Where and Why” computer program for K-12: $3,600. Role=co-PI (J. Kemeny, co-PI).

SERVICE (only last 10 years listed)

Outreach

2015-2016	Working with City of Bisbee on post-mining economic development plan
2014-2016	Member of Sahuarita School District External Advisory Committee with focus on creation of career technical education program for mining and manufacturing
2012-2017	Approximately 125 media interviews, presentations to mining companies, politicians, talks to community groups
2011-2017	Founding member of Arizona mining caucus and mining alliance
	Signed first dual degree program agreement with Mongolian government in Ulaanbaatar, March 2011
2010	Interviews on Chilean mine rescue (ABC and CBS affiliates)
	Interview on KGUN Morning Show
	Interview in Biz Tucson
	Briefing to Arizona gubernatorial candidate, Terry Goddard
	Meeting with Mongolian Minister of Education, Science, and Culture; Meetings with US Ambassador to Mongolia and members of Parliament, and several academic leaders
2008	Interview on KNST “John C. Scott Show”, March 11, 2008
2007	Interview on KUAT “Arizona Illustrated”, Oct. 2, 2007

National / International

2010	Interviews with Mongolian TV channels on proposed dual degree program
2008	Technical consultant and featured in new series on commodities for History Channel (to be aired late 2008/early 2009)
2007	Technical consultant and featured in “Faces of Earth” for Discovery HD, aired July 2007-August 2007; 4-part series

Citizenship

Intramural

Departmental

2009-2017	Director, Lowell Institute for Mineral Resources
2000-2014	Department Head duties

Colleges

2015	Chair, Tenure committee for Systems and Industrial Engineering
	Search Committee for Remote Sensing Cluster Hire
2014	Help create Global Mining Law Center
	Chair Regents Professor Nomination, College of Public Health
	Chair, Tenure committee for Systems and Industrial Engineering
2008	Chair, Department Head Search Committee, Civil Engineering and Engineering Mechanics
2014-2000	Department Head Duties
	Member, College Assessment Committee
	Conduct study of women in engineering undergraduate programs
	Organized CoEM women faculty gathering 9/26/00; helped organize college wide gathering for students and faculty 10/18/00

University

2014	Search committee for Vice President for Research and Discovery Communications Director
	Member, Search Committee for Executive Director University Research Business Development
	UA Renewable Energy Network executive committee
2014	Member of academic program review team for Lunar and Planetary Sciences; member of faculty interview team for Geosciences academic program review
2013-2014	President's advisory "Go To Team" for research explanations to the public and legislators
	Arizona 101 briefing to the Arizona-based staff for all congressional districts on mineral resources
	Briefings to Washington DC based staff on a periodic basis
2012	University Distinguished Lecture in Washington DC – rare earths

2007-2010 NSF ADVANCE grant team leader for data systems

Provost's strategic advisory committee on compensation

Extramural

2015-16 Chair, Committee on Earth Resources, National Research Council

Member, Board on Earth Science and Resources, NRC

2013-14 Member, SME Education Sustainability Taskforce

2012 Nominating committee SME

2011-2012 Chair, Accreditation and Curricular Issues, SME

Member, Strategic Committee, SME

2010 2016 Member, Committee on Earth Resources, National Research Council

2008 AGI Secretary

Chair, Board on Natural Resources NASULGC (now APLU)

Chair NIOSH MSHRAC

Organizing Committee SME 2010

2007 Secretary of the American Geological Institute (umbrella organization for 45 geosciences professional societies)

Member of the AGI Foundation

Vice-Chair Board on Natural Resources NASULGC

National Research Council Critical Minerals Study Committee

Chair, NIOSH Mine Safety and Health Research Advisory Committee

Vice-Chair Accreditation and Curricular Issues Committee of SME

Member of the Education Sustainability Task Force Steering Committee of SME

Continue to work on passage of Energy and Minerals School Re-investment Act

EXHIBIT B

Previous Four Years of Expert Testimony for Mary Poulton, Ph.D.

Dr. Mary Poulton has not testified as an expert at trial or by deposition during the previous four years.